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MORTALITY AMONG YOUNG FAT LAMBS.

INVESTIGATIONS IN SEASON 1927.

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Trials of Preventive Measures.

IN addition to continuing the research commenced in 1926 in Central Otago—of which an account was given in the *Journal* for April, 1927, under the title of "'Pulpy Kidney' Disease of Lambs"—some experiments were carried out during the past season in that district regarding the efficacy of the various preventive measures adopted for the purpose of combating the loss from this trouble. In spite of every effort to have these trials conducted under adequately controlled conditions, when it came to the point the controls were not as thorough as they might have been, owing to unavoidable circumstances connected with the season, &c. However, the results obtained are considered more reliable than any hitherto published in this connection, and it is felt that it will be useful to farmers who suffer losses of lambs to give an outline of the various experiments.

(1) OVERSTOCKING FROM LAMBING ONWARDS.

This was tried on a farm where heavy losses had been experienced for several years past. A paddock of 120 acres, where numerous deaths occurred last season, was partly ploughed and fenced off, so that 40 acres of the area was left in grass (very old pasture, mainly couch with a little rye-grass, suckling-clover, cocksfoot, and fescue), and eighty ewes were placed on the 40 acres about a fortnight before lambing. Deaths commenced here on 9th October. About the 20th the stock in the paddock was increased to 100 ewes and 116 lambs, although the older ewes were going back in condition. This paddock showed the highest death-rate on the farm—approximately 10 per cent., compared with an average death-rate in the other paddocks of about 4½ per cent.

Another somewhat similar experience may be mentioned. A farmer who lost heavily in the preceding year was visited early this season when deaths were just commencing. As an experiment he put two

mobs of ewes and lambs into one paddock. A further visit later in the season found this paddock grazed very close indeed, with the ewes and lambs in anything but prime condition, and yet there had been a considerably heavier loss in this overstocked paddock than in the others.

Apart from its not checking the death-rate, this practice is bad, because it certainly throws the ewes back in condition even if the lambs are not markedly affected. If persisted in, it means a considerable loss on the wool, besides greatly prejudicing the chance of getting the usual percentage of lambs away in the first draft to the freezing-works.

(2) EFFECT OF MARKING.*

Contrary to experience in many parts of New Zealand, particularly the North Island, marking appeared to have little, if any, beneficial effect as far as the mortality in Central Otago was concerned. In several instances deaths were few up to marking, and then during the succeeding few days were greatly increased. Several such instances were carefully investigated, and, save in a few cases, the deaths following the marking could not be attributed to blood-poisoning or other effects of the operation. In other cases, where marking was undertaken when a high rate of mortality was occurring, there was a check in the losses, but only for three or four days, and it seems very probable that this was due rather to the exercise, yarding, &c., entailed by marking than to the operation itself.

(3) EFFECT OF EXERCISE.

Only one controlled experiment was made, but several farmers tried it in a more or less haphazard fashion. The controlled trial gave the following results: Exercised mobs (totalling from 800 to 1,000), average death-rate 2½ per cent.; unexercised controlled mob of ninety lambs, loss eight, or approximately 9 per cent.

In another case the whole flock was exercised except the two-tooths, and here the death-rate was—Exercised mobs, average loss approximately 3 per cent.; unexercised two-tooths, average loss approximately 6 per cent.

A third farmer drafted out his twins and placed them on rich feed —low-lying rye-grass and clover paddock, thence to rye and lucerne, and finally to rye and cow-grass. He did not exercise these lambs. His singles were on terraces showing good feed—rye-grass, clover, and some cocksfoot—but not as good as that given to the twins—and in addition they were exercised daily. The difference in the death-rate of the two mobs is certainly striking in view of the popular opinion than twins are more or less immune from this trouble. It was as follows: Among singles, exercised, approximately 4 per cent.; among twins, unexercised, approximately 10 per cent.

The manner in which exercise was carried out in these cases was neither consistent nor particularly thorough, but is the best most farmers can do at such a busy time of the year. It consists of driving sheep about in the paddock with the dogs for a varying time each day. Some days a good half-hour might be devoted to a particular mob, whereas the next day only sufficient time might be available to rush

* This term as commonly used also includes castration and/or tailing.

them a few hundred yards or so. In spite of this, however, the cases quoted may be taken as fair examples, and they certainly show a saving in the losses.

(4) EFFECT OF YARDING.

Two different methods of yarding were tried. One proved of little if any benefit, whereas the other seems to offer the best means of prevention available.

Yarding Nightly.

From the time the lambs were a week to ten days old the mob was yarded up into a corner of the paddock (fenced off with standards and wire netting, with a big wing thrown out for driving purposes) every afternoon about 5 o'clock, and let out again about 8 or 9 o'clock the following morning. Details of the two cases in which this method was carried out are as follows:—

(*a*) Loss among yarded mob, 7·4 per cent.; losses among other lambs (excluding twins and two-tooths), approximately 3 per cent. This was the only controlled experiment of its type, and obviously in this single instance the large amount of extra work was worse than useless.

(*b*) In the second case there was not a proper control. Out of about forty-five early lambs, eight were lost from this disease, and judging by this a heavy death-rate among the main lot of lambs was anticipated. Advice was given to draft off the twins and to yard the single lambs each night as described. This was done, and as the twins were on good feed and no preventive measures were adopted they were, in a sense, controls. The losses were—among singles, yarded nightly, 1·8 per cent.; among twins, not yarded, 1·9 per cent. In previous years this farmer had had about the same loss among his twins as this season, but a much heavier mortality among his singles, so that he may have benefited more in reality than is shown by the figures.

This method entails a very great deal of extra work, especially when several paddocks have to be dealt with, and, on the face of it, appears of very little use as a preventive.

Yarding for Twenty-four Hours every Seven Days.

The method of yarding was the same as that described for nightly yarding. Once a week the mob was yarded up in the morning and left in till the same time the following day. Where this method was adopted it gave very good results.

One farmer, who gave it a tentative trial last season on his own initiative, consented to test it thoroughly this season with an adequate control. His results, which speak for themselves, were as follows: A mob of 434 lambs was divided into two equal lots; one lot was yarded for twenty-four hours every seventh day; the other was not yarded. The loss in the yarded lot was ½ per cent; the loss in the unyarded lot was 3 per cent. Out of 160 twin lambs (80 pairs) eight died. He then yarded the lambs for twenty-four hours; one was found dead in the yard, and none died afterwards. Out of some 1,900 lambs his total loss was under thirty, and of this total fifteen died out of 377 that were not being yarded. Thus the average death-rate over the whole flock was less than 3 per cent. The death-rate among the yarded lambs approximated 1 per cent., and that among

the unyarded lambs was approximately 4 per cent. Reckoning a lamb's value at the moderate figure of £1, a saving of 3 per cent. of lambs in this mob of 1,900 was equivalent to £57. It is a noteworthy fact that the death among the yarded lambs occurred either in the yards or just before yarding. It would appear from this that possibly an interval of seven days is too long, and that about five days would be better.

Another farmer had nine lambs die in a certain paddock. He was then persuaded to yard the mob for twenty-four hours; no more deaths occurred here for eight days, when one was found sick and died later; the lambs were then yarded again, and no more died. In another paddock where a heavy death-rate occurred last season three lambs died; the mob was then placed on a ploughed paddock for twenty-four hours, after which the deaths stopped.

One more case is worth quoting. A farmer who had lost sixteen lambs out of 270-odd was of opinion that nothing would check the death-rate; but as he happened to have a ploughed paddock conveniently placed he agreed to put the whole mob there for twenty-four hours. Only two more died after this was done.

SUMMARY.

The results of this season's experiments in prevention of the disease may be summarized as follows:—

(1) Overstocking paddocks from lambing onwards is useless, and apt to be actually harmful.

(2) So far as Central Otago, at any rate, is concerned, the check in the death-rate caused by marking is negligible; therefore this operation may be regarded as quite inadequate as a preventive measure.

(3) Exercise is certainly beneficial.

(4) Yarding nightly is cumbersome, and appears also to be of very doubtful benefit, besides giving the lambs a check.

(5) Yarding for twenty-four hours once a week has given very good results, with the additional advantage that it is the easiest method of all those tried. It is practicable on almost every farm where the losses occur, and a great point in its favour is that it gives neither ewes nor lambs any noticeable check. It is for the farmer himself to judge whether an interval of seven days or a shorter one of, say, five days does most good in his own particular case.

There seems to be a feeling amongst farmers who suffer from this mortality that preventive measures mean taking a great deal of trouble, and that it is very doubtful if benefit is derived. The foregoing outline shows definitely that a considerable measure of relief is obtainable. The principal difficulty is that on most farms the ewes are not drafted into mobs as they lamb. It is but rarely that the size of the paddocks precludes this. In the great majority of cases it is a practice which might easily be undertaken, and the comparatively few farmers who do it state that with a little foresight and organization it is quite simple and takes very little time, besides making subsequent handling of the flock much easier. Very little thought will show that the preventive measures here advocated can only be properly applied where this system of drafting has been carried out.

Other Investigations and Opinions.

Apart from the foregoing experiments, investigations of a technical nature were carried on concerning the exact nature of the disease, and several fresh points were acquired. As a result the work of investigation is still being carried on at Wallaceville, though it must necessarily be slow. No useful purpose would be served by publishing the lines of research being followed, and this will not be done unless something tangible and conclusive is obtained.

Arrangements are already on foot for a series of fresh experiments in different districts next season—concerned with the possibility of preventing the disease by the use of sundry mineral licks.

It may be well, in view of the fact that such opinions have been advanced by men of some authority and hence adopted by many farmers, to repeat definitely that the disease causing the mortality is not lockjaw (tetanus); neither is it pneumonia. The theory recently advanced in Southland that the common weed sorrel is the cause is dealt with in another article.

NOTE.—The writer wishes to acknowledge his indebtedness to the authorities of the Medical School, Dunedin, for the many facilities granted him in connection with this investigation; also to Mr. David Weir, Inspector of Stock, Ranfurly, for his ever-willing assistance.

THE SORREL-POISONING THEORY OF LAMB MORTALITY.

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As is generally known, a theory was recently advanced in Southland to the effect that the commonly occurring mortality among fat lambs is caused by sorrel poisoning. In view of the statement made, and quoted in the press, that proof of this theory had been obtained, it is deemed advisable to publish the attitude of the Department of Agriculture towards it, and some account of relevant experiments made at Wallaceville.

The evidence on farms where the mortality occurs is quite against the theory; but since odd plants of sorrel are to be found in almost any pasture, and as there is in sorrel a salt of oxalic acid which affects the kidneys, it was thought well to go into the matter experimentally. Sorrel itself is not poisonous, but the oxalate contained in it if taken in sufficiently large amounts damages the lining of the stomach and bowel, and causes inflammation of the kidneys (the organs which excrete oxalates from the system). Hence it was decided to experiment with rabbits and lambs by the following methods: (1) Injecting doses of oxalate solutions into the veins; (2) giving doses of oxalates by the mouth; (3) feeding sorrel.

EXPERIMENTS ON RABBITS.

So far as the rabbits were concerned, death could easily be induced by injecting about forty grains of sodium oxalate in solution into the stomach through a tube. This was fatal in under three minutes

in one case, but neither with the naked eye nor with the microscope could any abnormality be discovered in the kidneys. Another rabbit was killed by giving it a series of injections of oxalate solution into the veins. In this case there were changes in the kidneys that were readily detectable with a microscope, and crystals of oxalate could also be seen in the kidney-tubules; but the type of change noted was different from that seen in lambs whose kidneys are "pulpy"; moreover, in the so-called "pulpy kidney" of lambs one does not find oxalate crystals. A third rabbit, which had been fed on sorrel only, for a week, without showing any signs of illness, was killed and examined. No abnormality was found; the kidneys were normal and showed no crystals.

EXPERIMENTS ON LAMBS.

In these tests six lambs were used, with the following results:—

Lamb No. 4A: This lamb, about seven days old, was given a series of injections of sodium oxalate into the veins. When about 10 grains had been given, at the end of the second day, the lamb died suddenly. Examination showed the kidneys to be enlarged and pale. Microscopically there were changes like those noted in the rabbit similarly treated, and here again oxalate crystals could be readily seen in the kidney-tubules.

Lamb No. 1: This animal, about six weeks old, was fed with doses of oxalates and oxalic acid, and allowed to run with its dam. In the course of ten days it had received 56 grammes of these materials and was markedly ill. It showed none of the symptoms seen in cases of pulpy kidney, however, its illness evidently being due to inflammation of the stomach and intestines. It was then given a single large dose of oxalic acid, and died quietly about an hour later. On examination the kidneys were found seriously affected. Small hæmorrhages had occurred in them, giving a mottled appearance; they were also enlarged, but there was no pulpiness, although the examination was purposely left till four hours after death to give this every chance of occurring. Microscopically it was seen that the kidney-tubules were badly damaged and contained very numerous crystals of oxalate. The hæmorrhages had taken place exclusively *into* these tubules, which is another small point of difference between oxalate poisoning and pulpy kidney.

Lamb No. 5: This was two to three weeks old, and was treated similarly to lamb No. 1. In five days it received 34 grammes of potassium oxalate and 9 grammes of oxalic acid. It was then killed by a large dose of the latter, and examined some four hours later. The kidneys were certainly damaged, but to a far less extent than in No. 1. The changes that had occurred were of a similar nature.

Lambs Nos. 2 and 3: These were about five weeks old, and were fed on a diet entirely limited to sorrel, except for about ten minutes night and morning, when they were allowed to suck their dams. Feeding was commenced on 17th November, and for the first three days sorrel in the flowering stage was given, but from the 20th onwards young leafy sorrel from a field under crop was gathered for them. They were hand-fed three times a day, and ate on the average about 12 oz. to 16 oz. each per diem. This was continued for over four

weeks (until 18th December), and during that whole period neither lamb showed any sign of illness or distress, save that each had a transitory attack of diarrhœa lasting two days (No. 2 on 5th December and No. 3 on 29th November). The lambs were both killed a week after sorrel feeding had been discontinued, and a careful examination was made. Microscopically there was evidence that damage to the kidney-tubules had occurred of a similar nature though to a much slighter degree than was seen in Nos. 1 and 5. Moreover, a few oxalate crystals could be detected in No. 3.

Lamb No. 6: This was fed sorrel that had been mashed down in boiling water, and afterwards made to drink the water. A double handful of young sorrel-leaves was given in this way twice daily from 21st November to 18th December, without any ill effects being noticeable during that period or afterwards. The lamb was two to three weeks old when the experiment commenced.

COMMENTS.

Probably a perusal of these records will of itself be sufficient to show that oxalate poisoning is not the cause of the lamb mortality in the field, but a few additional comments may be made.

(1) Lambs Nos. 2 and 3 received far more sorrel than they could possibly have picked up for themselves when grazing an ordinary paddock. Further, although the oxalate present in the sorrel diet was sufficient to cause damage to the kidneys, far from causing sudden death it was not attended by illness of any sort.

(2) In none of the lambs experimented on was there any "fluid round the heart" or staining of the heart's inner lining, both of which conditions are constantly found in cases of pulpy-kidney disease as met with naturally.

(3) The changes produced in the kidneys by the oxalate treatments and the disease are somewhat alike, but by no means identical.

(4) The behaviour of a lamb after receiving large doses of oxalate (*e.g.*, lamb No. 1) is quite different from that of one suffering from pulpy-kidney disease.

(5) Samples of urine from cases of pulpy kidney in Central Otago were forwarded to the Department's Chief Chemist, who was unable to find any oxalates in them, whereas in samples from lambs 1 and 5 he found comparatively large amounts present.

(6) We did not find that lambs, even when hungry, showed any liking for sorrel, and while odd pieces might be eaten promiscuously with the other herbage, these experiments have shown that such small quantities are entirely harmless.

Nature of Pumice.—Pumice is a solidified volcanic froth. It contains all mineral food required by plants, but most of this is in an unavailable state, as it has been fused to a semi-vitreous condition. By the aid of organic matter and such farming operations as produce compaction of the soil and the incorporation of organic matter, pumice may be slowly decomposed. Green manuring is the best of all methods for improving pumice soils.—*B. C. A.*

PLANT-BREEDING AT CANTERBURY AGRICULTURAL COLLEGE.

WORK ON CEREALS, GRASSES, AND RED CLOVER.

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I. HISTORICAL OUTLINE.

BY the year 1860 wheat-growing was an established industry in Canterbury, and the area devoted to this crop expanded continuously until 1880, when the average annual area amounted to 300,000 acres. During the earlier part of this period very numerous varieties of wheat were introduced, but by 1870 the commonly used varieties had become narrowed down to Tuscan, Hunter's, and Pearl, and this has governed the millers' and merchants' classification of New Zealand wheats from that time to the present day. Individual farmers, of course, still made occasional importations, but none of these (except Solid-straw Tuscan) was able to establish itself, largely owing to the fact that the old varieties had become wind-resistant by natural selection, while new introductions were badly shaken by the nor'westers.

During all this period there was no attempt at improvement of seed. New strains of the old varieties could not be introduced from England because they had gone out of cultivation there, so that even the names were lost, and there was no idea of systematic improvement from within. An occasional farmer rogued a few acres for seed, and a fairly clean crop was eagerly bought up by neighbours, but on the whole the different varieties were extremely mixed and impure. In 1909 an average crop contained 20 per cent. of impurities, and in many cases the wheats in a field were so mixed that it was impossible to guess which variety the farmer had intended to sow.

In 1910 Mr. R. E. Alexander, present Director of this College, suggested that an attempt be made to improve the wheats of Canterbury by the method of pure line selection, which had proved so successful with barley in Ireland, and the work was entrusted to the present writer. It was carried on in a small way out of the slender resources of the College, but in 1915 the first success had been achieved and the pure line known as College Hunter's had been distributed. In 1920 the Government, through the Department of Agriculture, provided for the continuance and extension of the work by making an annual grant of £500. Selection of oats was then undertaken in addition to further work on wheat. In 1921 the limit of improvement by selection among our New Zealand wheats appeared to have been reached, and crossing among pure strains was commenced.

In 1923 an extensive series of crosses was made between New Zealand wheats and the most promising of those from other parts of the world, and at the same time a very modest start was made in the selection of grasses. This work looked so promising that in 1925 the Department of Agriculture increased its annual grant to £1,000, and an assistant, Mr. J. W. Calder, was appointed to help in the work.

Selections of cocksfoot and rye-grass were made, not from the vicinity of the College alone, but from all the chief sown-grass areas

throughout the South Island, from Nelson to Invercargill. In 1927 a start was made with selections of red clover, and in the same year Parliament made a statutory grant towards the experimental work at the College, the share of the plant-breeding department coming to about £1,600 a year.

II. SELECTION WORK IN CEREALS.

(a) Methods.

A factor that has influenced the methods used is the kind and area of ground on the College farm. This yields an average of 45 bushels of wheat per acre. It is almost all absolutely flat, extraordinarily even in chemical and mechanical composition, and perfectly drained. It is divided into fields of about 25 acres in extent, and between 400 and 500 acres are under the plough each year. Any one of a dozen fields is available for plant-breeding plots, and there is always available a field that has borne a crop of rape or Italian rye-grass in the preceding season. Thus there is ample space available, the same ground has not to be used more than once in ten years, unevenness of soil is reduced to a minimum, and self-sown cereals do not occur among the plots. Owing to the size of the farm and the presence of working students at the College, both horse and hand labour are available whenever they are wanted, so that the facilities for breeding-work are probably as good as at any place in the world.

The unrestricted area of suitable ground has had a considerable effect on the choice of methods of trial. Single-ear selections are made from commercial crops, and each year and of each variety about one hundred head-to-row plots are sown in a permanent "bird-cage" enclosure. Elaborate trials have been made throughout the years to find which arrangement of plots would give the smallest probable error, whether chess-boards, or rows singly or in groups, and with replications up to ten in number. The result has been to abandon the expectation of any yield results from the bird-cage, and to rely on various forms of trial in the field.

About 25 per cent. of the rows are rejected on appearance or handling. Rows are eliminated if they show weakness of straw or too great length of straw, but especially if they show looseness of grain in the chaff, this character leading to shaking of the grain in the heavy hot winds that are common during the ripening season. Disease has little significance here. Rows are cut by sickle, and the bundles hung in a large shed until threshing. The thresher used consists of an old peg-drum machine from which the concave has been extracted, and on to the pegs of whose drum wooden beaters have been tied. Each sheaf is put in a cotton clover or timothy seed bag, and its heads held in the bag, against the beaters. When it is threshed the straw is thrown away, and grain and chaff emptied into a wire-gauze riddle, whence the chaff is blown away by an electric fan. The method is not as quick as some others, but it is cheap and efficient, and the maintenance of purity of the grain is absolute. Another 20 per cent. of the strains are rejected on grain sample.

In the second year the seed is sown in the open field, areas being carefully chosen for freedom from feerings or finishes in the last or any

traceable preceding ploughing. The strains are sown in three-row plots, each row about 15 ft. (or a rod) in length; the three-row plots of each strain are replicated three, four, or five times, as the seed permits. Every fifth three-row plot is a check. A few strains are rejected on sight or handling; the middle row of each of the survivors is harvested separately, and its two outside rows together. At first only the middle rows are threshed, in bags as before; then the seed is weighed and examined, and the worst yielders and those of worst quality are eliminated.

Certain strains remain, usually about thirty out of the hundred heads originally selected. Of these thirty, the sheaves made up of their two outside rows are now threshed, and all the seed of the same strain is bulked, dressed, and pickled ready for sowing.

The strains remain only one year in the bird-cage and one year in the rod-row plots. After that all trials are by field methods. Beaven's* half-drill-strip method is employed for testing strains against the parent variety, because these nearly always sow at the same rate. A fifteen-coulter drill is used; the middle coulter is blocked, the seed-box divided into two by a partition, and one-half receives the seed of the strain and the other half that of the parent variety. The drill is driven wheel on wheel mark, and the result is that one has pairs of plots separated by 14-in. spaces (our drill coulters are 7 in. apart), the number of pairs being limited only by the amount of seed available, or by the number of times that one chooses to drive up and down the field. The plots are drilled obliquely (usually at 45°) to the last ploughing, which means, in rectangular fields, obliquely to all preceding ploughings as well.

The plots are about 49 in. wide, and they are cut by a binder having a 54-in. knife. This allows perfectly clean cutting, and each row of sheaves as it lies on the ground represents a plot. Threshing is done in the field by a specially adapted locally made threshing-machine. This will thresh up to 50 bushels of wheat per hour, and the six men that are used for threshing can, when they become skilled, clean the machine out to the last grain in seven minutes. All the plots of one strain are threshed in succession, and weighings (but not cleanings out) take place after threshing the last sheaf of each plot. The yields are compared by Student's method.

The amount of seed available from the three-row rod-long plots replicated four or five times is about 4 lb., and this sows four to five strips 2 chains to 2½ chains long. That this method can be used with so small a quantity of seed is due, first, to the large area at our disposal, and, second, to the structure of colonial drills, which will sow to the last grain, and which can be completely cleaned out in a few minutes. The small number of replications made with the seed available does not, of course, allow of the best strains being selected, but it allows an elimination of a few of the worst.

Next year the same method is adopted, but an unlimited number of replications is possible. It has been found that 3 chains is a suitable length of plot, and that twenty replications give a result that makes a difference of 2 per cent. in the yield — that is, 1 bushel per acre — significant. This number of plots is therefore sown, and the resulting three or four best strains are selected.

* Beaven, E.S.: "Trials of New Cereals," *Jour. Ministry Agric.* XXIX, 4, 1922.

These few strains are grown by the half-drill-strip method for three or four more years; one is finally selected as the best available from the original hundred selections, and if it has for four or five years given a significant increase over commercial seed it is considered good enough to distribute to farmers.

The seed produced from the half-drill strips is unavoidably contaminated by seed from adjacent plots, and therefore this seed, while good enough for yield trials, is not good enough to sell as a pure strain. The pure seed is obtained by the following device: Just before the first half-drill-strip harvest—that is, before the strain has ever been touched by binding or threshing machinery—a few hundred heads of each strain are gathered and stored, it may be for one or two years. When it becomes obvious which strains are likely to be in the running for the final selection, the hand-selected sheaves of these strains are threshed and sown in a solid block well isolated from other strains. Each of these blocks is harvested and threshed with special care, and grown in a solid block again next year. Thus, when the final selection has been made and tested for a sufficient number of years, there is somewhere else on the farm a field of 20 or 25 acres of wheat of the same strain in a high state of purity and ready for immediate distribution.

SUMMARY OF METHODS.

First year: One hundred head-to-row plots in bird-cage. Threshed in bags.

Second year: Three-row plots hand-sown in field; three to five replicates; rows rod-long. Comparison by middle rows. Threshed in bags.

Third year: Field methods; half-drill strips, three or four replicates of blocks six coulters wide by 2 or 3 chains long. Threshed by machine. (Before harvest, hand selection of heads to provide pure seed.)

Fourth year: Twenty replicates of half-drill-strip plots about 3 chains long. After threshing, strains reduced to three or four.

Fifth year: Twenty replicates of the three or four strains, which are thus reduced to two or one. (Hand-selected heads of the three or four strains threshed and sown.)

Sixth year: Twenty replicates of two or one strains, allowing final selection. (Pure seed of two or one sown for multiplication).

Seventh year: Twenty replicates of final selection for confirmation. (Pure seed of that selection sown in a field, giving about 1,000 bushels for distribution.)

(b) Results to Date.

(1) WHEAT.

With wheat in the condition described earlier (page 156), plant-breeding at the College had every chance of easy success. Following is a brief account of the several varieties selected:—

1915: College Hunter's.—A pure line of the variety locally known as Hunter's was distributed after what we should now consider very imperfect trials. For three years it had yielded an average of 9 bushels per acre over bought seed. Owing to its purity as compared with the then available seed, it was favourably received by farmers, and the

accidental circumstance of its having a striking and beautiful colour was a fortunate advertisement of the beginning of our plant-breeding work. Its yield under all trials in various localities showed that it was probably 4 bushels per acre better than unselected Hunter's, which it rapidly replaced. In 1916 there were nineteen fields of Hunter's on the road between the College and Christchurch; two of these were the College strain. In 1917 there were twenty-two crops along the same road, and twenty of these were the pure strain. By 1918 the unselected seed had entirely disappeared. Twenty per cent. of the wheat grown in New Zealand is College Hunter's, the average yearly area being about 50,000 acres. This success, coming so early in the history of the trials, was an important factor in the public interest and support of the work of plant-breeding in New Zealand.

1918: College Solid-straw Tuscan.—This is a pure line of the variety locally called Solid-straw Tuscan. It yielded during five years of trials about 3 bushels per acre better than bought seed, but on other farms more adapted to this particular variety its superiority was more pronounced. Owing to its lack of any distinguishing feature, its reputation among farmers has never equalled that of College Hunter's, but it gradually permeated all Tuscan areas; and it is now certain that practically all the Solid-straw Tuscan in New Zealand is descended from this particular selection. "College Tuscan" probably accounts for 60 per cent. of the wheat grown in New Zealand—say, about 150,000 acres annually.

1918: College Purple-straw Tuscan.—A selection from a mixed crop of White-straw Tuscan, this wheat had very strong straw and a fair-quality grain. However, it filled no special niche in Canterbury farming, and could not stand the competition of Solid-straw Tuscan. It therefore was used for only two or three years, and then went out of cultivation.

1918: College Pearl.—A selection from the variety locally known as Pearl. The strain was about 2 bushels per acre better than commercial seed, and the quality of the grain was very good and even. The wheat shook badly, however, and was soon replaced by the strain next recorded. It is now nearly extinct.

1920: College Velvet.—A selection from the variety locally known as Velvet. The strain yielded only 1 bushel per acre better than the commercial variety, and this was the best strain procured after ten years' trials. It was therefore decided to distribute it, because Velvet was a variety much desired by millers and the then available seed was very impure. Apparently the strain filled a want, and all the Velvet grown in Canterbury is now descended from it. Its wind-resistance is good for the variety, and its milling-quality is the best among all New Zealand wheats. College Velvet now accounts for 10 per cent. of the wheat grown in New Zealand—say, about 25,000 acres.

(2) OATS.

1923: College Algerians.—This is a selection from Algerian seed, originally brought from Australia, which had undergone natural selection in New Zealand for about fifteen years. The strain tillered well, recovered quickly after feeding off with sheep, gave a grain with a somewhat reduced proportion of husk, and during five years of trial at the

College beat commercial seed by 11 bushels per acre. It was an immediate success, increased yields of 20 bushels per acre being not infrequently recorded. By 1925 the ordinary market reports quoted College Algerians at 6d. a bushel above unselected seed, and two Christchurch firms between them sold 20,200 bushels of the seed, of which 3,000 bushels went to the North Island. Practically all the Algerian oats now grown in New Zealand are descended from this strain. It is grown in the South Island for threshing, for chaff, and for green feed for sheep in autumn and winter, and in the North Island for chaff and green feed. There is also a certain export trade in the seed to Tasmania and other Australian States.

1925: College Danish.—A selection from a yellow-skinned oat locally known as Danish. The strain yielded 3·5 bushels per acre better than commercial seed, but it never attained any popularity; the variety had largely gone out of cultivation, as it has no merits different from those of Garton's Abundance, the standard white oat of the country. College Danish is grown in only a few isolated localities, and will doubtless soon die out.

1925: College Duns.—A selection from the variety known locally as Dun oats—probably the English Winter Grey. The strain is of good quality, and outyielded commercial seed by 4·4 bushels per acre during four years of trial. The variety, however, is not very widely grown, and the strain is infested with or sports into a fatuoid impurity that has checked its free distribution. A purified line is now in process of multiplication.

(c) Detailed Results for Harvest of 1927.

Most of the work done during the season consisted of variety trials —which this article does not record—or of crossbred trials, which are recorded under Section III. A few strains were under trial as follows:—

(1) BELL'S SELECTION FROM COLLEGE HUNTER'S WHEAT *versus* COLLEGE HUNTER'S (see page 159).

John Bell was a student at the College in 1920. In a crop of College Hunter's he noticed one plant whose general characters were those of the main crop, but whose heads were noticeably more dense. The plant was saved, threshed, and grown as follows:—

1921–22: A single row for observation.

1922–23: A small multiplication plot.

1923–24: In field—Five plots of about $\frac{1}{20}$ acre each; total weight of Bell, 238 lb.; total weight of Hunter's, 236 lb. In small plots—a ten-replicate chess-board—Bell better than Hunter's by 12 per cent. Odds in favour of significance, thousands to 1.

1924–25: In field—Twelve replicates of half-drill-strip plots. Bell 7 per cent. better than Hunter's. Odds in favour of significance, 117 to 1.

1925–26: In field—Fourteen replicates of half-drill-strip plots; College Hunter's, 50 bushels per acre; Bell, 54·6 bushels per acre; advantage in favour of Bell, 9·2 per cent.; odds in favour of significance, 2,000 to 1. In small plots—Eight replicates of three-row plots; increase over College Hunter's, 13·9 per cent.; odds in favour, thousands to 1. In small plots—Single rows, Hunter's and Bell alternating sixteen times; increase over Hunter's, 6·5 per cent.; odds in favour, 30 to 1.

1926–27: In field—Twenty-three replicates of half-drill strips. Increase over Hunter's, 1·1 bushels per acre; odds in favour of significance 103 to 1. The figures of this last trial are shown in Table 1.

It will be seen that on the whole series of years Bell has outyielded College Hunter's.

Table 1.—Comparison of Bell's Strain and College Hunter's, 1927.

Plot No.	Kilos per Plot.		
	Hunter's.	Bell.	Difference in Favour of Bell.
A 14	Lost in threshing	Lost in threshing	..
15	16·05	15·30	—0·75
16	16·35	16·40	0·05
17	17·03	17·25	0·22
18	16·81	17·20	0·39
19	17·80	16·85	—0·95
20	15·84	16·25	0·41
21	15·40	15·40	0·00
22	14·90	15·00	0·10
23	15·40	15·00	—0·40
24	16·00	16·45	0·45
25	15·90	16·85	0·95
B 14	16·85	18·35	1·50
15	17·50	18·70	1·20
16	18·35	20·20	1·85
17	21·10	20·50	—0·60
18	17·35	19·20	1·85
19	18·25	19·82	1·57
20	16·90	16·55	—0·35
21	15·80	16·55	0·75
22	15·65	15·90	0·25
23	17·95	18·00	0·05
24	17·20	18·00	0·80
25	17·70	18·50	0·80
Means	16·82	17·31	0·44 = 1·1 bush. per acre.

NOTE.—Odds in favour of significance of result, 103 to 1.

(2) ALGERIAN OATS—PURE LINE B. 49 IN COMPETITION WITH COLLEGE ALGERIANS (see page 160).

The strain was originated from a head picked at random from a commercial crop in 1920.

1920–21: One of the best ten out of one hundred.

1921–22: Small plots—One of the best three of the above ten.

1922–23: No trial—multiplication only.

1923–24: Five replicate plots, each of about $\frac{1}{20}$ acre. Yield, 9 bushels per acre better than College Algerians.

1924–25: Twenty-four replicate half-drill strips. Yield, 7 bushels per acre over College Algerians.

1925–26: Similar trial. Advantage for B. 49 = 3·1 bushels per acre

1926–27: Eight similar replicates. Advantage in favour of B. 49, 5·6 bushels per acre; odds in favour of significance, 600 to 1.

Details of this last trial are given in Table 2. By mistake in drilling, guard plots were omitted, so that Plot pairs 1 and 13 (the outside ones)

could not be used in calculation. The small mill used to thresh B. 49 did not remove the awns at all completely, so that the strain was difficult to sow. In Plots 2, 9, and 10 there were obvious misses in the rows, so the pairs involved in those plots were also omitted from the calculations.

Table 2.—Yield of Algerian Strain B. 49 in Competition with College Algerians.

Plot No.	Kilos per Plot.		
	College Algerians.	B. 49.	Difference in Favour of B. 49.
Plot 3	40·1	45·5	5·4
4	35·3	46·8	11·5
5	43·7	45·0	1·3
6	42·3	50·2	7·9
7	42·5	50·4	7·9
8	51·1	49·3	−1·8
11	37·4	49·1	11·7
12	36·0	42·1	6·1
Means	41·1	46·6	6·2 = 5·6 bush. per acre.

NOTE.—Odds in favour of significance of result, 600 to 1.

III. CROSS-BREEDING OF CEREALS.

(a) Methods.

The methods adopted for selecting among the progeny of cross-breds are only slightly modified from those already described (page 157), and are briefly summarized as follows:—

First year: Cross made and seed sown.

Second year: All F. 1 sown.

Third, fourth, and fifth years: F. 2, &c., sown in plants to rows. Selection of promising strains by inspection. Testing for homozygosity for visible characters, and starting a new family with any individual variant now appearing.

Sixth and seventh years: Three-row plots, 1 rod long, replicated four or five times, the standard variety being inserted as check every fourth plot. From one hundred to two hundred families reach this stage. Elimination (largely arbitrary) of most strains, leaving twenty or thirty. (Single-ear selection started within the best families to secure greater degree of fixity, and to start supply of seed unmixed by subsequent half-drill-strip trials.)

Eighth to eleventh years: Half-drill-strip trials with constant elimination of families, and increasing exactness of trials of the survivors. (Building up pure supply of seed of the final selection separate from the half-drill strips as already explained.)*

(b) Results to Date.

Improvement by selection having been exploited until the rate of improvement was seriously slowed down, crossing was started in 1921 between pure strains. Only one cross has reached any advanced stage. This is the cross between College Hunter's and College Solid-straw

* Conf. Love, H. H.: A Program for Selecting and Testing Small Grains, *Jour. Amer. Soc. Agronomy*, XIX, 8, Aug., 1927.

Tuscan, and the object is to obtain the good grain quality and yield of Hunter's in combination with the solid straw and tightness of chaff of Tuscan. Many of the families show the combination to a promising degree.

In 1925-26 some of the families that had early proved homozygous were tried in 5-chain rows with Hunter's as alternate checks. The winter was abnormally wet, which may have given the crosses a special advantage. The yields for the first five families as compared with Hunter's were 140, 150, 140, 100, and 108 per cent. respectively. Many other families were tried in 1-rod rows.

In 1926–27, again, many families were tried in rod rows, and others of which most seed was available were sown in half-drill strips in competition with Hunter's. The results for the same five families as above were 114, 111, 103, 100, and 108 per cent. respectively.

In the present year families are being tested in half-drill strips, the number of replicates varying from five to thirty.

IV. SELECTION IN GRASSES.

The two most important sown grasses in the South Island of New Zealand are rye-grass and cocksfoot. The commercial seed consists of enormous numbers of strains all mixed up, and our first step in 1923 was to demonstrate this fact. We went into a field that had been sown in commercial cocksfoot, and grubbed up plants here and there, broke each down till it consisted of a single tiller, planted that in good soil till it grew into a clump, and broke the clump up into a row. When the rows were compared they showed that some plants produced three or four times as much feed as others. A single field produced an almost infinite number of types of leafage, habit of growth, date of flowering, resistance to drought, resistance to frost, earliness of spring growth, and any other economic characters that were considered. Two rows that happened to be growing side by side are shown in Fig. 1.

It was then argued that if there are different types of cocksfoot (or rye-grass) and a mixture of these types is sown in any special locality, then some will be more suited to the soil and climate of that locality than others are. Those that are least suited to the environment will die out soon, and those that are best suited will survive longest, so that an old pasture where the cocksfoots have almost all died out will contain only those types selected by nature as suitable for that special environment. For instance, on our dry shingle plains a reasonable stand of cocksfoot in its second or third year will in ten years be reduced to a few scattered plants, each many yards from its neighbour, and with the intervening spaces filled with weed grasses. Now, the assumption is that these scattered plants are those selected by nature as suitable to the dry shingle plain, and so we go to an almost exhausted field on such land and collect a hundred or two of the surviving plants. These are then broken down until one is sure that there is only one plant in the tuft. The tuft is grown in a garden until it becomes a fair-sized clump, and then all the clumps are taken back to the dry shingle plain, and there divided and planted out in rows for observation. Out of the hundred rows, all composed of plants assumed to be permanent on shingly country, one (theoretically) can be selected after a few years' trial as showing the best combination of economic characters ; and then

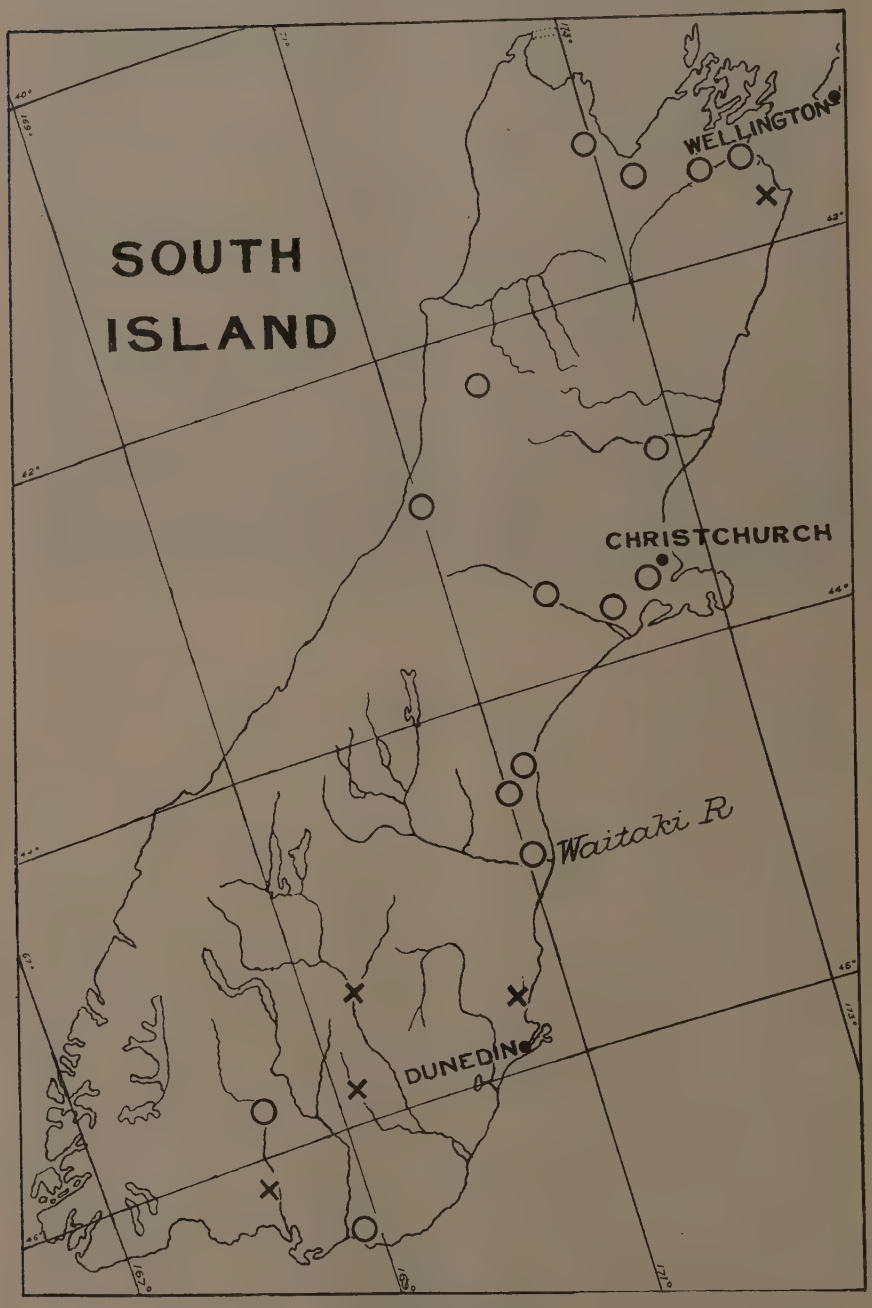
FIG. I. TWO STRAINS OF COCKSFOOT SEPARATED OUT OF ORDINARY NEW ZEALAND SEED.

we shall be able to say, "Here is a cocksfoot permanent on your country, and highly productive, frost resistant, drought resistant, &c., there." As a matter of practice, not one but a few rows are likely to be thus finally selected.

In the belief that nature must make this selection among the enormously heterogeneous rye-grasses and cocksfoots she has to work on, we have gathered some of the strains she has approved from all the chief types of sown grassland in the South Island: from dry shingle plains near Nelson, Blenheim, Christchurch, Timaru, and Lumsden; from wheat-growing land at Blenheim and Lincoln, on the Timaru Downs, and near Tapanui; from cattle-grazing land with high rainfall in two places on the West Coast — Koiterangi and the Grey Valley — from Omimi near Dunedin, and from Waimahaka in Southland; from the clays of the Moutere Hills near Nelson; from the lucerne land of Seddon; from the limestone faces of Waikari; from 2,500 ft. up on the front ranges of the mountains; from the almost desert area of Central Otago—in fact, from every region where we found a considerable and important area of any type of sown grassland. The localities of our plots are shown on the accompanying map.

Whether nature actually has produced such physiological ecotypes as our mode of work assumes we have never put to direct trial, for we have so far almost invariably grown each selection in its own environment. In the few cases where selections from two environments have been grown together distinct evidence of these physiological ecotypes has been noticed, though it appears that the formation of structural ecotypes has not gone as far as it has in England.* This, indeed, was

* Stapleton, R. G.: "Value of Selection, &c.," *Report Imperial Botanic Conference*, London, 1914.



MAP OF SOUTH ISLAND OF NEW ZEALAND, SHOWING LOCATION OF COLLEGE GRASS-TESTING PLOTS.

Circle (o) signifies established plots; cross (×) signifies plots in preparation.

to be expected from the comparatively short time that the English grasses have been growing here, and from the fact that it is not yet the custom to sow seed from one's own locality. When and where that custom prevails the formation of ecotypes in the same grasses will probably proceed with considerable rapidity.

Of course, all the work of selection would be useless unless there could be obtained from the selections seed that would reproduce the characters of its parent. That there is good hope of this being achieved we have gained some satisfactory evidence. In April, 1924, we chose several distinct types of rye-grass and cocksfoot, and planted

FIG. 2. SHOWING THAT SHELTER FERTILIZATION OF RYE-GRASSES PRODUCES SEEDLINGS OF HOMOGENEOUS CHARACTER.

(*a*, above) Seedlings of C 2—spready type; (*b*) seedlings of C 15—upright type.

small clones* of each type on a yard-square patch hoed out of the middle of a 30-acre field of oats and tares. Each clone was 5 chains from any other grass, and the lines of clones ran at right angles to our only hot and dry wind. The oats were Algerians, which when sown in March can be relied on to shoot by 1st November, so that at the time the grasses flowered the oats were 18 in. or 2 ft. taller than the grass flower-stalks. The tares had climbed high up the oats, so that each clone of grass was practically in a well of oats and tares, screened from drifting pollen to a considerable degree. Seed produced under these circumstances we have called "shelter-fertilized" seed.

A large quantity of seed was produced from each clone, and it was sown immediately after harvest in a greenhouse. Germination was generally fair, but in some cases poor. Growth was rapid, so that the seedlings were ready to plant out in the open with the first autumn rains, and by the following November were sufficiently far advanced for comparison. The seedlings from each clone were planted in a double row containing about sixty plants.

It is clear that if the parent clones were heterozygous for a considerable number of important characters, and if they were open pollinated, all the rows of seedlings would be alike. The measure by which the seedlings in any row are alike *inter se*, and different from those in other rows, is a measure of the efficiency of shelter pollination, and of the prospect of obtaining seed producing different types of the same grass. It was evident on inspection that each row consisted of seedlings very similar to each other in habit of growth and other economic characters, and that the separate rows were very different from each other. Two such rows are shown in Fig. 3.

To express the similarities and differences in figures, counts were made of certain easily observed characters in two adjacent rows of rye-grass, with the following results:—

Table 3.—Showing Differences between Seedlings of Two Clones Shelter-fertilized.

	C 2.	C 15.	Difference.
Number of flowering stems per plant on 23rd November in first year	30·7 ± 1·66	43·4 ± 2·38	12·7 ± 2·86
Angle of flowering stems to the horizontal	44·8 ± 1·01°	79·0 ± 0·66°	34·2 ± 1·17°
Length to top cauline leaf ..	20·5 ± 0·25	17·4 ± 0·27	3·1 ± 0·37 cm.
Width of top cauline leaf at 1 in. from base	7·20 ± 0·08	6·26 ± 0·07	0·94 ± 0·1 mm.

It will be seen that C 2 shelter-fertilized seed produced plants that were significantly fewer-flowered (or later flowered), more spreading, longer-leaved, and wider-leaved than the plants similarly produced from C 15.

In the case of the cocksfoot, at the same time as the shelter-fertilized seed was produced, self-fertilized and open-fertilized seed of some of

* A "clone" is a group of plants produced vegetatively (not by seed) from a single parent.

the same clones was also obtained. All three lots of seed were sown at the same time, and when the resultant seedlings were a year old both they and their parent plant were broken down into clones, each clonal plant consisting of a single tiller.

In a typical case there are forty-seven rows, each row a clone, and every clone given the same start in its present location. There are four rows of the parent plant; three rows, each of which is a clone of a plant sprung from a self-fertilized seed; twenty rows similarly produced from shelter-fertilized seed; and twenty rows of open-fertilized seed. If shelter fertilization is a useful practical procedure, then the twenty shelter rows ought to be nearly as similar to the parent rows as the self-fertilized rows are, and much more nearly similar to the selfed rows than the open-fertilized rows are. Unfortunately, the plants are not sufficiently far advanced to make measurements of particular characters, but inspection makes it clear that the above-demanded similarities

FIG. 3. SHOWING DIFFERENCE BETWEEN TWO ROWS OF RYE-GRASS SEEDLINGS.

and differences do indeed exist. Most of the shelter-fertilized rows have at present the same growth-form as the parent, and can be easily recognized as that parent's offspring, while among the open-fertilized rows there are all the differences that would be ordinarily expected among an equal number of chance selections. It is clear that this assumes that the parent plant was homozygous for many outstanding characters, and that this is so is proved by the similarity *inter se* of the three rows of selfed plants obtained.

In other cases the character of the selfed plants shows that the parent plant was heterozygous for the most obvious characters, but as far as we are yet able to judge the proportion of plants homozygous for outstanding characters is by no means small.

One further piece of evidence of the efficacy of shelter fertilization is available. In two cases we have rye-grass clones of parent and their shelter-fertilized offspring, and as these plants are further advanced

FIG. 4 (*a* AND *b*). TWO ROWS OF RED CLOVER GROWN UNDER THE SAME CONDITIONS.

Showing two of the many strains mixed in our ordinary New Zealand seed.

towards maturity than are the cocksfoot, some measurements were possible. The length and width of certain leaves were measured; the differences in these characters between the parent were not significant, and the differences between the offspring were non-significant also. In one feature, however, there was a marked difference between the parent plants, and this was completely reproduced in the offspring, as shown in the following table :—

Table 4.—Showing that Offspring by Shelter Fertilization resemble Parents.

	Angle of the Flowering Stems to the Ground.	
	C 2.	C 5.
Parent	52·5 ± 1·2°	75·0 ± 0·9°
Offspring	44·8 ± 1·01°	75·9 ± 0·8°

It thus appears that shelter fertilization is a means of producing from seed fairly homogeneous crops of rye-grasses similar to their parent strains.

In the case described only 1 sq. yard was given to each clone to be shelter-fertilized, and enough seed was produced to sow thinly a plot of 48 sq. yards. If we found a rye-grass of sufficiently outstanding merit, and proved it homozygous for a sufficient number of characters of economic importance, we could raise a hundred times that quantity of seed by the same process—that is, enough to sow a field of about an acre. Inter-fertilization of most of the plants of such a field might be assumed, and so seed would be ready for immediate distribution.

V. SELECTION IN RED CLOVER.

This work was begun only in the early part of 1927. A field in the wheat-growing area was chosen which had been sown in grasses and clovers five years ago. A few scattered red-clover plants still survived, and these were dug up and examined for size of roots. Only those that appeared to be really old were chosen, and any that appeared to have arisen by reseeding were rejected. We thus hoped to secure the most permanent strains. Cuttings of the selected plants were made after the method of Sylven, of Svalof,* nipping off pieces of the stem about an inch below each node, and sticking the pieces into garden soil in a greenhouse. About 50 per cent. of the cuttings struck roots, and these were planted out in rows in early spring. Each original plant has thus produced a row of plants by vegetative propagation, and the rows can be compared. There are great differences in the habits of growth, date of flowering, and quantity of leafage among the various rows (see Fig. 4), as Williams† shows there are among the clovers of various nationalities. There seems to be a prospect of our being able in course of time to select a strain of red clover prolific and reasonably long-lived under our conditions of soil and climate.

* Sylven, Nils: *Sveriges Utsadesforenings Tidskrift*, Hefte 5, 1925.

† Williams, R. D: "Red Clover Investigations," Welsh Plant Breeding Station, 1927.

USE OF THE BURDIZZO CRUSHER.

BEARING ON THE FROZEN-MEAT INDUSTRY.

J. LYONS, M.R.C.V.S., Director, Live-stock Division.

AN article warning against the improper use of an instrument known as the Burdizzo crusher or pincers, when used for the purpose of emasculating lambs, was published in the *Journal* for July, 1926. Since then the use of this instrument has increased among stockowners to a considerable extent. This no doubt is due to the fact that the method is seemingly more easily applied than any other, and also that the operation is bloodless. After noting carefully the effect of its application, however, a further word of caution is necessary with regard to its use.

When the instrument is being used care should be exercised to crush only one cord at a time, and to see that it is crushed; otherwise the operation is imperfectly performed. When used across the top of the scrotum or purse in order to catch both cords at once, there is a danger of cutting off the blood-supply to the parts underneath, in which case the whole purse may become gangrenous and slough off, thereby endangering the young animal's life.

When the instrument is used in the manner advised on calves and lambs that are well grown and with testicles fairly well developed, no exception can be taken to it. When used on very young lambs, however, it is doubtful if the operation will prove successful, and it is questionable if the designer ever intended the instrument to be used on such animals. In young lambs the testicles and cords are small and imperfectly developed; in many cases the cords are so slender that it is doubtful if the pincers close tight enough to get the proper grip to satisfactorily crush the cord. The result is an improper castration, and complete atrophy or wasting does not follow.

Even in those cases where the operation is performed satisfactorily it is doubtful if sufficient time is allowed to elapse between castration and the time of killing for the frozen-meat trade to allow the organ to waste sufficiently. Already there have been complaints from meat-works owing to the testicle not wasting after this method of castration. Further, in the case of two-toothed wethers castrated in this manner as lambs, the possible classification of them by the slaughtermen as "stags" is liable to be an endless source of trouble and dispute, while the lowered value of "stag" carcasses may ultimately be reflected in the price obtained by producers.

To sum up, while the Burdizzo crusher is capable of and will do satisfactory work when used on calves and lambs with well-developed testicles, I have no hesitation in stating that in the case of young lambs or calves the work performed is unsatisfactory, and breeders would be well advised to return to the old methods when castrating such animals.

New Zealand Wool Committee.—Mr. Herbert Hill has been appointed a member of this committee in place of Mr. L. B. Andreae, resigned.

PASTURE TOP-DRESSING EXPERIMENTS IN OTAGO, SEASON 1927–28.

R. B. TENNENT, N.D.D., Instructor in Agriculture, and A. A. HUME, A.R.C.Sc.I., Assistant Instructor in Agriculture, Dunedin.

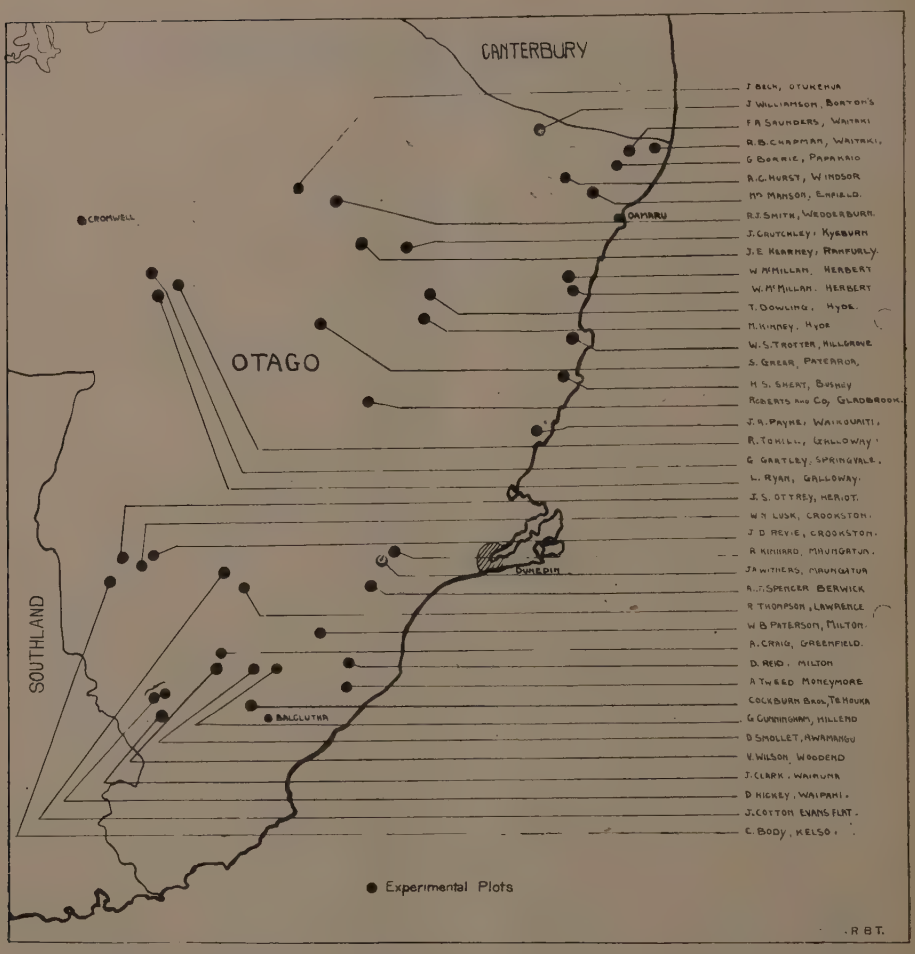
DURING the past few years considerable interest has been evinced in Otago in regard to the practice of top-dressing pastures. The results claimed by the application of fertilizers in different parts of the Dominion naturally caused many Otago farmers to suppose that similar results could be obtained in their province, and as a consequence the Fields Division in Dunedin has been inundated with inquiries asking for specific information as to the advisability of adopting the practice of top-dressing, and discarding the well-established practice of ploughing up old pasture and sowing down young grass.

Sufficient general information had already been collated by the instructional staff of the province to indicate that in some localities remunerative returns could be obtained from the application of certain fertilizers to pastures which had apparently outlived their usefulness, but on examination this information proved indefinite and in many cases open to doubt. It was therefore decided to inaugurate an extensive series of experiments on top-dressing, these to cover a wide area and to embrace within their scope a large number of soil-types and pastures of varying ages and condition. To this end the co-operation of the New Zealand Farmers' Union was enlisted, and as a result forty-two co-operative experimental plots devoted solely to top-dressing experiments were laid down and cut for hay during the past season. The wide distribution of these plots can be seen from the accompanying map (next page).

In arranging the scope of the experiment it was decided to adhere to a uniform plan throughout, using the drill strip method, thus allowing all results to be examined statistically. The method of laying out the plots was practically the same as that used by Mr. A. W. Hudson for the Fields Division experimental work in Canterbury, which has been fully described in the *Journal*. With the exception of three plots which were laid down during the season 1926–27 all plots received similar treatment. The plan of the experiments was comparatively simple, being to test the efficacy of phosphates both alone and in conjunction with lime, and further to acquire definite information as to the value of lime alone on pastures.

The phosphates under trial were superphosphate (44–46 per cent. grade) and basic slag (Trifolium brand, 17–20 per cent. grade). These manures were applied at a uniform rate of 3 cwt. per acre, and to ensure accuracy in this respect a drill belonging to the Department was utilized throughout. Carbonate of lime in a finely ground form was used at the rate of 1 ton per acre. The plots were dressed with the various treatments during the months of July, August, and September. Some of the dressings were therefore given at a comparatively late period, and this fact has to be taken into consideration in examining the first year's results.

At an appropriate period the plots were shut up for hay. On account of the large number of plots to be harvested it was naturally



MAP SHOWING LOCATION OF THE PASTURE TOP-DRESSING EXPERIMENTS IN OTAGO.

not feasible to get each plot dealt with at its peak point of production. This accounts for plots situated on high-class land in some cases showing comparatively low weighings when compared with those on poor soil-types. The yields given throughout in no way represent the relative fertility of the different plots.

The only gauge utilized in estimating the effect of the various fertilizers was the green-weight increase of the treated plots over the untreated or "control" plots. This obviously is not an ideal method of estimating the effect of top-dressing, but when taken in conjunction with the character of the pasture constituents on the various plots it affords a reasonable indication if any one treatment or combination of treatments is giving better results than untreated plots.

An endeavour has been made to present the results in a manner intelligible to farmers, for whom this investigation has been primarily

conducted. To this end all green weights harvested have been converted into estimated hay weights, and the yield per acre of hay is thus shown. An arbitrary value of £5 per ton has been given to all hay harvested, and from that has been deducted the value of the crop. Against this value the cost of the various fertilizers has been placed, and a profit or loss table over the control plot worked out.

In presenting these tables it is to be noted that the hay values only represent the amount of material harvested during the comparatively short period of time (about ten weeks on the average) during which the plots were closed to stock. The full cost of the fertilizers used has for convenience been debited against the hay thus produced. No residual effect has been taken into account, and it is only reasonable to expect that for the next few years the effect of certain fertilizers will be noticed on some portions of the plots. Again, it is to be pointed out that thirty-nine of the plots are in their first year of treatment, consequently no great effect from lime can as yet be expected. It is intended to carry on the experiment with these plots for a number of years in order to ascertain the length of time over which the effects of the different fertilizers used will be felt. For the next few years, therefore, the results of these experiments will be presented to farmers, and the profit or loss shown on each plot will be adjusted from year to year. For convenience this season's results are divided into groups —namely, North Otago, Central Otago, and South Otago.

North Otago.

(1) J. G. WILLIAMSON, BORTON'S.

This paddock, situated on rolling country adjacent to the Waitaki River, had been sown down with rape in 1923, no manure being used. The pasture before top-dressing had run largely to goose-grass, sweet vernal, and crested dogstail, small quantities of rye-grass, cocksfoot, and red and white clover showing through. The plot was top-dressed on 17th August, 1927, closed to stock on 1st October, and harvested 5th December. Results are shown in the following table:—

Table 1.

Number of Paired Plots.	Manure.	Mean Green Weight of Plot.	Significant (S) or Non-significant (N).	Estimated Weight of Hay per Acre.	Value of Hay per Acre.	Cost of Manure per Acre.	Profit or Loss compared with Unmanured Plot.
		lb.		T. cwt. qr.	£ s. d.	£ s. d.	£ s. d.
30	Basic slag ..	6·8	N	0 10 1	2 11 3	0 15 0	0 1 3 (loss)
30	Basic slag and lime	7·9	N	0 12 0	3 0 0	1 8 0	0 5 6 (loss)
24	Superphosphate ..	29·1	S	2 4 0	11 0 0	1 1 0	8 1 6 (gain)
24	Super and lime ..	28·7	S	2 3 2	10 17 6	1 14 0	7 6 0 (gain)
44	Lime	6·4	S	0 9 3	2 8 9	0 13 0	0 1 9 (loss)
..	Control.. ..	4·9	..	0 7 2	1 17 6	..	..

Summary: The effect of superphosphate on this plot was very striking; red clover responded to it most vigorously. No apparent results in the composition of the pasture could be noted at time of

FIG. 1. PLOT ON J. G. WILLIAMSON'S FARM, BORTON'S.

Two strips top-dressed with superphosphate, showing heavy growth of clover. Control strip in between.

FIG. 2. END VIEW OF THREE TOP-DRESSED STRIPS ON SAME FARM.

Note clover growth in superphosphate strips (centre).

cutting from either lime or basic slag. This plot was kept closed to allow the aftermath to come away, and again the strips receiving superphosphate showed up most vividly. On the aftermath more clover growth could be noticed in the basic-slag strips than in the control strips

(2) R. G. BORRIE, PAPAKAIO.

The pasture utilized in this experiment is situated at the foothills of Papakaio, on a heavy piece of country locally described as a "tarry" soil, typical of a small area in the immediate vicinity. Sown down in 1904 with a mixture of rye-grass and red and white clover, it still held a fair sole of rye-grass and clover. Crested dogstail, sweet vernal, and other poorer types of vegetation, however, were gradually replacing the good grasses. No manure has been used on this pasture since it was sown down over twenty-three years ago. The plot was top-dressed on 23rd August, 1927, closed to stock 1st October, and harvested 6th December. Results were as follows:—

Table 2.

Number of Paired Plots.	Manure.	Mean Green Weight of Plot.	Significant (S) or Non-significant (N).	Estimated Weight of Hay per Acre.	Value of Hay per Acre.	Cost of Manure per Acre.	Profit or Loss compared with Unmanured Plot.
		lb.		T. cwt. qr.	£ s. d.	£ s. d.	£ s. d.
30	Basic slag and lime	18·4	S	0 16 0	4 0 0	1 8 0	0 10 6 (loss)
30	Basic slag ..	16·6	S	0 14 2	3 12 6	0 15 0	0 5 0 (loss)
30	Superphosphate ..	29·4	S	1 6 0	6 10 0	1 1 0	2 6 6 (gain)
30	Super and lime ..	34·7	S	1 10 1	7 11 3	1 14 0	2 14 9 (gain)
40	Lime	17·9	S	0 15 2	3 17 6	0 13 0	0 2 0 (gain)
..	Control	14·4	..	0 12 2	3 2 6	..	..

Summary: As will be noted, superphosphate with lime gave the greatest increase over control. Lime alone showed a significant response, as also basic slag alone and basic slag with lime. It was observed that those strips top-dressed with super alone and super with lime showed a much heavier clover content than all other strips.

(3) A. C. HURST, WINDSOR.

This plot represented a considerable area of typical low hill country of the Windsor district, being situated on quite good land. The pasture had been sown down with rape in 1922, a meat-works manure being used at the rate of 1 cwt. per acre. The grasses used were cocksfoot, perennial rye-grass, crested dogstail, and cow-grass. The pasture showed distinct signs of deterioration, inferior grasses appearing in the sward. The cow-grass had given way to white clover. The plot was top-dressed on 18th August, 1927, closed 12th October, and harvested 20th December. Table 3 (next page) shows the results.

Summary: No great weight increases were observed on this plot, but there was an undoubted increase in white-clover content on those

Table 3.

Number of Paired Plots.	Manure.	Mean Green Weight of Plot.	Significant (S) or Non-significant (N).	Estimated Weight of Hay per Acre.	Value of Hay per Acre.	Cost of Manure per Acre.	Profit or Loss compared with Unmanured Plot.
		lb.		T. cwt. qr.	£ s. d.	£ s. d.	£ s. d.
36	Basic slag ..	27·4	S	1 4 0	6 0 0	0 15 0	0 2 6 (loss)
30	Basic slag and lime	28·7	S	1 5 0	6 5 0	1 8 0	0 10 6 (loss)
36	Superphosphate ..	34·0	S	1 9 3	7 8 9	1 1 0	1 0 3 (gain)
30	Super and lime ..	31·9	S	1 7 3	6 18 9	1 14 0	0 2 9 (loss)
32	Lime	26·3	S	1 3 0	5 15 0	0 13 0	0 5 6 (loss)
..	Control.. ..	24·7	..	1 1 2	5 7 6	..	..

strips receiving superphosphate. All differences in yields from the various fertilizers are significant, and, as will be observed, in this case super gave the highest weight increase. The effect of lime was practically negligible.

(4) MRS. MANSON, ENFIELD.

This plot is located on a typical "tarry," heavy soil at Enfield. The pasture had been laid down about 1917, the grasses used being chiefly cocksfoot, rye-grass, crested dogstail, and red clover. At the date of laying down the experimental plot the pasture had chiefly gone to cocksfoot, crested dogstail, and white clover, with a large proportion of inferior grasses and weeds showing through. The plot was top-dressed on 19th August, 1927, closed 1st October, and harvested 8th December. Results are tabulated below:—

Table 4.

Number of Paired Plots.	Manure.	Mean Green Weight of Plot.	Significant (S) or Non-significant (N).	Estimated Weight of Hay per Acre.	Value of Hay per Acre.	Cost of Manure per Acre.	Profit or Loss compared with Unmanured Plot.
		lb.		T. cwt. qr.	£ s. d.	£ s. d.	£ s. d.
30	Basic slag ..	19·5	S	0 17 0	4 5 0	0 15 0	0 5 0 (loss)
30	Basic slag and lime	19·7	S	0 17 1	4 6 3	1 8 0	0 16 9 (loss)
30	Superphosphate ..	36·9	S	1 12 1	8 1 3	1 1 0	3 5 3 (gain)
30	Super and lime ..	35·0	S	1 10 2	7 12 6	1 14 0	2 3 6 (gain)
40	Lime	17·6	S	0 15 1	3 16 3	0 13 0	0 11 9 (loss)
..	Control.. ..	17·3	..	0 15 0	3 15 0	..	..

Summary: On harvesting this plot the super strips could be clearly defined on account of the increase of white clover thereon. Super and super with lime gave the heaviest weighings, forming quite a good sole on the strips so treated. No other treatments showed visible response, despite the fact that when their weights were analysed slight significant increases were recorded.

(5) W. McMILLAN (WINDMILL PADDOCK), HERBERT.

This pasture had been sown down in 1925 with rye-grass, crested dogstail, and red and white clover. Although naturally decreasing in rye-grass content, it is still well covered with this grass. The pasture, therefore, when top-dressed was in good condition. The plot is situated on low country adjacent to the coast. Top-dressing took place on 24th August, 1927; the plot was closed 1st October, and harvested 9th January, 1928. Table 5 gives results.

Table 5.

Number of Paired Plots.	Manure.	Mean Green Weight of Plot.	Significant (S) or Non-significant (N).	Estimated Weight of Hay per Acre.	Value of Hay per Acre.	Cost of Manure per Acre.	Profit or Loss compared with Unmanured Plot.
		lb.		T. cwt. qr.	£ s. d.	£ s. d.	£ s. d.
30	Basic slag ..	24·9	S	1 1 3	5 8 9	0 15 0	0 3 9 (loss)
30	Basic slag and lime	28·8	S	1 5 1	6 6 3	1 8 0	0 0 9 (gain)
30	Superphosphate ..	28·6	S	1 5 0	6 5 0	1 1 0	0 6 6 (gain)
30	Super and lime ..	29·4	S	1 5 3	6 8 9	1 14 0	0 2 9 (loss)
40	Lime	26·8	S	1 3 2	5 17 6	0 13 0	0 7 0 (gain)
..	Control.. ..	22·4	..	0 19 2	4 17 6	..	..

Summary: A general increase of clover from all treatments was noted on this plot, a combination of superphosphate with lime giving the heaviest yield. Lime alone gave quite a significant increase over the unlimed plots, and in this respect it is to be noted that the pasture is comparatively young. The results from this plot should afford some interesting points next season.

(6) W. McMILLAN, HERBERT.

This pasture had been sown down in the autumn of 1921 with oats, the grasses used being rye, dogstail, and red and white clover; no manure was used. The pasture had deteriorated considerably, a fair proportion of Yorkshire fog and brown-top taking charge. The plot was top-dressed on 24th August, 1927, closed 1st October, and harvested 10th January, 1928. Results were as under:—

Table 6.

Number of Paired Plots.	Manure.	Mean Green Weight of Plot.	Significant (S) or Non-significant (N).	Estimated Weight of Hay per Acre.	Value of Hay per Acre.	Cost of Manure per Acre.	Profit or Loss compared with Unmanured Plot.
		lb.		T. cwt. qr.	£ s. d.	£ s. d.	£ s d.
30	Basic slag ..	14·1	S	0 11 0	2 15 0	0 15 0	0 17 6 (loss)
30	Basic slag and lime	15·5	S	0 12 0	3 0 0	1 8 0	1 5 6 (loss)
30	Superphosphate ..	16·0	S	0 12 2	3 2 6	1 1 0	0 16 0 (loss)
30	Super and lime ..	16·5	S	0 13 0	3 5 0	1 14 0	1 6 6 (loss)
40	Lime	15·7	S	0 12 1	3 1 3	0 13 0	0 9 3 (loss)
..	Control.. ..	14·5	..	0 11 2	2 17 6	..	..

Summary: This plot was really not advanced enough for harvesting, being extremely slow in making recovery. The weights throughout were poor, and in no way indicate the possibilities of this pasture. A perusal of the results will show that although there is little difference in the yields recorded for the various treatments the differences are significant. This would indicate that under more favourable conditions of growth greater differences between treatments would be recorded. The plot will be closed to stock at a more opportune time next season. It should be noted, however, that the six strips top-dressed with superphosphate stood out quite plainly, on account of the greater proportion of white clover growing upon them.

(7) W. S. TROTTER, HILLGROVE.

Sown down about 1902, this pasture had run mainly to sweet vernal with a sprinkling of white clover throughout. The pasture was miserably poor, and little result was anticipated from the manurial treatment. Top-dressing took place on 15th August, 1927; the plot was closed 1st October, and harvested 9th December. The following table gives results:—

Table 7.

Number of Paired Plots.	Manure.	Mean Green Weight of Plot.	Significant (S) or Non-significant (N).	Estimated Weight of Hay per Acre.	Value of Hay per Acre.	Cost of Manure per Acre.	Profit or Lose compared with Unmanured Plot.
		lb.		T. cwt. qr.	£ s. d.	£ s. d.	£ s. d.
30	Basic slag ..	21·4	S	0 18 3	4 13 9	0 15 0	0 5 0 (loss)
30	Basic slag and lime	25·0	S	1 1 3	5 8 9	1 8 0	0 3 0 (loss)
30	Superphosphate ..	34·1	S	1 9 3	7 8 9	1 1 0	2 4 0 (gain)
30	Super and lime ..	35·2	S	1 10 3	7 13 9	1 14 0	1 16 0 (gain)
44	Lime	21·8	S	0 19 1	4 16 3	0 13 0	0 0 6 (loss)
..	Control.. ..	19·3	...	0 16 3	4 3 9	..	..

Summary: Excellent results were obtained from superphosphate, the recovery of white clover being most marked. It appeared incredible that a response of this degree could be obtained on such a run-out pasture, the superphosphate strips with their dense mats of clover showing out most clearly. Slag also responded, but to a much less visible degree than super. Although an increase in weight was obtained as a result of liming, no visible difference could be noted. This plot was kept closed to allow an aftermath to grow, and again the strips top-dressed with super showed out most markedly.

(8) H. S. SHEAT, BUSHEY.

The pasture upon which this plot was situated is reported to be over twenty-five years of age. For such an old pasture its condition prior to top-dressing was very satisfactory, there being a good sole of rye-grass and white clover. Naturally, a fair proportion of brown-top and crested dogstail showed throughout. The plot was top-dressed on

25th August, 1927, closed 8th October, and harvested 8th December. Results are presented below:—

Table 8.

Number of Paired Plots.	Manure.	Mean Green Weight of Plot.	Significant (S) or Non-significant (N).	Estimated Weight of Hay per Acre.	Value of Hay per Acre.	Cost of Manure per Acre.	Profit or Loss compared with Unmanured Plot.
		lb.		T. cwt. qr.	£ s. d.	£ s. d.	£ s. d.
30	Basic slag ..	37·7	S	1 13 0	8 5 0	0 15 0	0 3 9 (gain)
30	Basic slag and lime	39·2	S	1 14 1	8 11 3	1 8 0	0 3 0 (loss)
30	Super	43·5	S	1 18 0	9 10 0	1 1 0	1 2 9 (gain)
30	Super and lime ..	46·5	S	2 0 2	10 2 6	1 14 0	1 2 3 (gain)
40	Lime	37·2	S	1 12 2	8 2 6	0 13 0	0 3 3 (gain)
..	Control.. ..	33·4	..	1 9 1	7 6 3	..	..

Summary: Superphosphate in conjunction with lime gave the highest return, a much closer sward of white clover being observed in this treatment. No apparent differences could be noticed in the cross-dressings of lime; an increase, however, was recorded in their weighings. As will be noted, all treatments gave a significant increase.

FIG. 3. PLOT ON W. S. TROTTER'S FARM, HILLGROVE.

Dense mat of white clover in superphosphate strip (centre). Control on left; basic slag on right.

(9) J. A. PAYNE, WAIKOUAITI.

The pasture selected for this trial was laid down in 1915. Since that date it has been used largely as a horse-paddock, much coarse, rank vegetation growing upon it. From a pasture viewpoint this paddock was in poor condition, on account of the prevalence of brown-top and rank fog and cocksfoot. White clover was interspersed throughout. Top-dressing took place on 25th August, 1927; the plot was closed 1st October, and harvested 19th December. Table 9 gives results.

Table 9.

Number of Paired Plots.	Manure.	Mean Green Weight of Plot.	Significant (S) or Non-significant (N).	Estimated Weight of Hay per Acre.	Value of Hay per Acre.	Cost of Manure per Acre.	Profit or Loss compared with Unmanured Plot.
		lb.		T. cwt. qr.	£ s. d.	£ s. d.	£ s. d.
30	Basic slag ..	14·5	S	0 12 3	3 3 9	0 15 0	0 1 3 (loss)
30	Basic slag and lime	13·6	S	0 11 3	2 18 9	1 8 0	0 19 3 (loss)
30	Superphosphate ..	16·3	S	0 14 1	3 11 3	1 1 0	0 0 3 (gain)
30	Super and lime ..	16·8	S	0 14 3	3 13 9	1 14 0	0 10 3 (loss)
40	Lime	13·0	S	0 11 1	2 16 3	0 13 0	0 6 9 (loss)
..	Control.. ..	11·4	..	0 10 0	2 10 0	..	..

Summary: At the date of harvesting the plot showed a very uneven appearance on account of the great variability of the soil-fertility. This can be largely attributed to the horse-manure scattered throughout, and emphasizes the difficulty of obtaining uniform results on a pasture of this nature. As will be observed from the table, small differences were recorded. A distinct difference in clover content could be observed in those strips top-dressed with superphosphate. More definite results can be looked for from this experiment next season, as it is Mr. Payne's intention to keep horses off the plot. The removal of the coarse grass will also result in more even growth.

(10) J. B. CHAPMAN, WAITAKI.

This was an extremely interesting experiment on an old pasture dating from about 1892. The pasture, situated on the gravel terrace of the Waitaki River, had run to Danthonia pilosa, sweet vernal, goose-grass, and suckling-clover. Numerous other grasses and plants were prevalent throughout the pasture, all of an inferior nature. Definite information was sought in regard to the effect of top-dressing this type of grassland, and a plot was accordingly laid down on 22nd August, 1927, and closed on 20th October.

The plot was kept under close observation for a period of twelve weeks. Very little growth took place on any of the strips. The only difference which could be observed was a distinct increase in suckling-clover on those strips top-dressed with superphosphate. The growth on the whole plot was too light to harvest; consequently observations only could be made. No effect could be observed from basic slag or lime. On this year's results even the increase in suckling-clover could

not justify top-dressing. The plot will again be closed for observation next season. In the meantime, however, it appears that top-dressing an old run-out pasture on this type of soil will not pay. These remarks do not apply to young grass, Mr. Chapman having obtained encouraging results from his own experiments on new pastures.

(11) R. F. SANDERS, STEWART SETTLEMENT.

This pasture is a purely native one, mainly composed of Danthonia pilosa, into which had encroached such species as goose-grass, English hair-grass, and sweet vernal, while a small amount of suckling-clover could be noticed throughout. The pasture is situated on the old gravel terrace of the Waitaki River, and the experiment was conducted to afford information as to the effect of top-dressing this class of grassland. In many respects the plot resembled that of Mr. J. B. Chapman (No. 10), and the results obtained were practically similar. Top-dressed on 16th August, 1927, the plot was closed to stock on 1st October. Close observation was made at various times throughout the period. A fair general growth took place over the plot, but proved too light to harvest. A definite increase in suckling-clover content on those strips top-dressed with superphosphate could be noted. No other treatment appeared to have taken effect. The increase of suckling-clover in this year's results could not justify the expense of top-dressing. Bearing in mind the dryness of this class of country it will be interesting to observe next season's results.

STATISTICS OF TOP-DRESSING ON FARMS.

INFORMATION regarding areas top-dressed in New Zealand, together with the kinds and quantities of fertilizer applied, was collected in the 1926–27 season for the first time. The summarized figures show that 1,521,259 acres were top-dressed, the total quantity of fertilizer used amounting to 4,383,002 cwt., or 219,150 tons. With reference to the total area quoted, and obtained by adding together the areas top-dressed with the fertilizers stated, it should be borne in mind that this figure is not an accurate representation of the actual total area top-dressed. This is accounted for by the fact that in many cases where farmers top-dressed the same area with two or more of the fertilizers quoted, either separately or as a mixture, duplication of such areas under the appropriate fertilizer headings undoubtedly resulted. Consequently the actual total area top-dressed would be correspondingly less.

Nature of Top-dressing.	North Island.		South Island.		Dominion.	
	Area.	Quantity used.	Area.	Quantity used.	Area.	Quantity used.
	Acres.	Cwt.	Acres.	Cwt.	Acres.	Cwt.
Superphosphate	825,811	2,038,641	159,351	314,909	985,162	2,353,550
Basic slag	252,328	730,410	10,440	28,359	262,768	758,769
Other artificial fertilizers and manures	152,218	452,024	9,641	30,624	161,859	482,648
Stable and farm manure	3,683	..	792	..	4,475	..
Lime	52,898	266,832	54,097	521,203	106,995	788,035
Totals	1,286,938	3,487,907	234,321	895,095	1,521,259	4,383,002

—*Census and Statistics Office.*

THE FEEDING OF LIVE-STOCK.

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III. FOODSTUFFS IN COMMON USE.

THE present series of articles has so far dealt with the chief constituents in the plant foods which are utilized by stock. An endeavour has been made to explain in simple terms what the constituents are, and for what purposes they are used by the stock.

To summarize, it has been stated that the chief plant-constituents used are the proteins, the carbohydrates, the fats or oils, the ash or mineral portions, the vitamins, and, lastly, water. It is from these substances that the necessary elements for growth, fattening, milking, &c., are derived. They are consumed, digested, and passed through a process of elaboration, according to the type of stock, before being stored in the animal body or used for milk-production, &c.

It has been explained how the protein or the nitrogenous portion may be utilized in necessity to replace a deficiency in the carbohydrates, and how the converse cannot take place. But where farm crops constitute the chief source of food it may be concluded that the utilization of proteins for this purpose will never occur, it being more likely that stock will suffer a partial protein starvation on home-grown foods unless care be exercised.

The discussion then passed on to consider the uses made of the various food materials, and the influence of the food on the different processes. The effect of a liberal protein-supply on milk-production was stressed as a very important factor. It both increases and stimulates production.

These aspects of the subject having been dealt with, attention will now be directed to the various foodstuffs in common use. At the present day this constitutes rather a formidable list of materials. A few of the more important concentrates should be of interest to a small section of the community, but special attention will be given to home-grown foods.

PASTURE.

There is a continuous change all over the country, a gradual passing from one type to another from the point of view of both quality and type of grasses which go to make the pasture. As one passes from fertile valleys up to the high ranges this change in quality, although possibly not observed in its gradual course on adjacent farms, becomes very obvious at either extremity.

In the high ranges nothing but the poorer grasses can be maintained, so that before the season advances too far lambs for meat-production have usually to be removed and fattened off on more liberal and nutritious places. In many instances, in fact, young breeding-stock would greatly benefit in constitution if they could be wintered off. Inclement weather plays a very important part with the stock, but it also affects their grazings. The greatest difficulty for hill stock is to pass the spring of the year successfully. This is the season when their

food-supplies are down to a minimum, and, unfortunately, little can be done to avoid it owing to the difficult nature of the country, ordinary methods of grassland-improvement frequently being impracticable.

Another type of grassland which should be noted by all stockmen is that with a calcareous soil. This is always very healthy stock-country and invariably easily handled; it is very amenable to treatment and always improves greatly with good husbandry. It is also greatly benefited where a little cultivation is done for the stock.

The remaining types of permanent pasture, although varying very much as a whole, may be treated as one. The grasslands of New Zealand outside the aforementioned may nearly all be regarded as in this class, as comparatively little land is laid down to temporary pasture. Permanent pasture is frequently held to be the best type obtainable. That is rather a big assertion to make, but it will be agreed that if well cared for and in good heart it is very economical and productive. Unfortunately, it suffers very greatly and becomes of low productivity if not given a great deal of attention, which frequently requires much hard thought.

So far as New Zealand is concerned, nature takes the major part of the responsibility in maintaining the pastures. Growth is normally abundant and luxuriant for a great part of the year—so much so that one finds considerable indifference to its management among a fairly large number of farmers. Although conditions are so suitable to growth, it must be remembered that all types of grasses are encouraged, and if the farmer does not maintain a continuous effort inferior species will very soon gain the upper hand of the finer grasses, even to their complete exclusion. Grassland, being the staple diet of our stock, should receive all the attention which it requires. The quality of the stock and the quality of their feeding are two things which cannot be separated. The one is just as important as the other.

Perhaps the greatest drawback to permanent pasture is its liability to become seriously fouled. One frequently hears of land being "pig-sick" or "cattle-sick" (no specific disease in New Zealand is now referred to), but the truth of the matter is more plainly and truly described when the land is said to be fouled or contaminated.

As regards short-rotation or temporary pastures, the chief benefit lies in their being composed of a greater proportion of superior grasses and cleaner in every respect. They are thus more healthy for stock. This type of pasture is only possible where a limited amount of cropping is being carried on.

Pasture-management.

The management of pastures from the point of view of animal husbandry is not, on the whole, a very difficult or complicated procedure. The first essential to be grasped by the farmer concerns the methods of grazing adopted by the various kinds of stock. The horse, for example, is a very selective grazer. Wherever horses are grazed the paddock becomes very patchy, because he grazes only certain portions, leaving the remainder to grow coarse. Again, it must be remembered that although the horse may graze certain areas closely he only does that of necessity, as he grazes by means of his prehensile lips. The horse is the most difficult animal to pasture of all, and, where possible, should never be allowed to graze alone.

Sheep, again, graze very closely, and devour all the fine bottom grasses, and leave the others; this is the great difficulty with them. Dairy cattle, on the other hand, are very uniform grazers, grazing quite freely and only avoiding the very coarse grasses.

It may be seen from the foregoing brief remarks that, by a judicious manipulation of stock, pastures may be kept under proper control. That, of course, does not mean that the great growth of summer-time can be properly controlled or eaten and kept down by stock alone. Pasture can only permit of an even number of stock being maintained. This results in overstocking during the winter season and understocking during the summer. This cannot be easily avoided, which is unfortunate, for although the grasses are not all eaten they lose very considerably in value as they reach maturity.

About this same period aftermath becomes available, and adds greatly to the grazing, especially for dairy cows. Where the aftermath is from newly sown grass it should be very lightly grazed. It benefits by a light grazing, but if that cannot be done it is better left without stock till the spring. Sheep especially may do considerable damage to young grass. In many cases it may be advisable for autumn purposes to have some specially sown crop available for stock-feeding. In very few cases, in fact, would this fail to be beneficial.

Spring and autumn are the trying times for the pastures, and if grassland is too heavily stocked immeasurable damage will be done to farm and stock alike. Care is necessary and judgment required to keep land stocked to its greatest capacity, and the only possible way that this can be safely done is by having adequate resources of other foodstuffs available.

For pasture to be consistently nutritious it should be liberally manured and as completely as requirements demand. This subject will not be discussed here, except for one point—namely, that lime is the most health-giving material which the farmer has for his stock. Lime should be used wherever circumstances allow.

In general, pasture land gives the best returns where grazed and rested alternately.

ROOT CROPS.

Roots provide the great bulk of the succulent roughage for winter use. Where they can be grown successfully they are a valuable type of food and greatly relished by farm stock. The main objection is their cost of production, and in some cases the difficulty in growing them. But roots fill a very special purpose. They have a very beneficial effect on the health and production of milking-cows, ewes, and other stock. The nutritive value of roots lies in their carbohydrate content, which is chiefly in the form of sugar, and that fact explains why they are easily assimilated. Protein and fat may be regarded as deficient in them.

The growing of roots serves a twofold purpose—it is a cleaning crop for the land as well as a source of food. The first purpose is often not fully taken advantage of.

To obtain the greatest returns from a root crop dairy stock ought to be rationed, and sheep should be folded on to a limited area and that cleaned up before the stock is allowed to move on. The method frequently adopted of allowing the stock to roam all over a root

paddock has really nothing in its favour. The method is fundamentally wrong; it is wasteful, or, rather, extravagant; it is not conducive to good health, and it generally makes a quagmire of the land. In too many instances it must be described as the limit of carelessness. But, even so, some benefit is obtained by the stock. Roots have a characteristic laxative effect, which is very beneficial, especially to dairy cows.

For pigs, roots form a very valuable supplementary food. Often the animals are allowed to feed the crop off; but better results, of course, are obtained when the roots are pulled and fed with other food. When pigs are being hand-fed about 5 lb. of roots per day is as much as will be consumed. As fattening advances the roots should be reduced in daily quantity and given in small amounts.

Turnips and Swedes.—The storage of roots greatly enhances their feeding-value, owing to a rise in the sugar content, especially in swedes. This root, therefore, should be reserved for winter and early spring use. Swedes especially should not be fed when freshly pulled. The value of turnips over swedes lies in the fact that they ripen earlier and are ready for use in autumn. This, having regard to their composition, makes them a useful supplement to pastures which are failing Frosted leaves of turnips may cause serious digestive troubles.

Mangolds.—Mangolds are very useful in the dairy herd for later use, or, rather, after the swedes are finished and spring growth has not yet commenced. They have a slightly higher feeding-value than swedes, this being due to an increase in the sugar content and other soluble carbohydrates. Newly lifted mangolds have a very severe laxative effect. They should always be pulled and allowed to lie a considerable time before feeding—not hours, but days, or even weeks. Mangolds should not be fed continuously to male sheep, as they may cause the deposition of urinary calculi (gravel in the water).

Carrots. — Carrots are considered particularly valuable as a horse-feed, but they are also fed to cows. The red or yellow varieties impart a beautiful rich colour to the milk, owing to the colouring-matter, carotin, which they contain. In some districts carrots are grown as a supplementary forage for sheep. Carrots have a slightly higher feeding-value than mangolds. For feeding, carrots should be regarded as having an equivalent value of 7 lb. to 1 lb. of oats. They contain the same amount of dry matter as potatoes, but only half the feeding-value. Raw carrots, however, are more valuable than raw potatoes. They are excellent feeding for sick animals. Horses in work should receive from 6 lb. to 8 lb. per day

Rape is used either for pasturage or as a soiling crop for sheep and swine, but it may be cut and fed green to cattle, having proved an excellent feed for all three classes of stock. Owing to its high water content and its narrow albuminoid ratio (1 : 4·3) it does not feed well alone, but ought to be fed along with low-protein feeds, such as maize, cereals, and wheat middlings, or with pasture or hay. It is a valuable crop, especially for autumn use, more particularly in the fattening of lambs and sheep.

Kales, Cabbage, &c.—These form a very useful feed for autumn use when pastures are failing, but are no better than some other more cheaply produced auxiliary crops.

Pumpkins.—This crop has not assumed very great importance as a feed, but when grown is fed to cattle, sheep, or swine. In composition it resembles quite closely the turnip. Some feeders are doubtful about the value of the seeds, but these should never be wasted.

Potatoes.—The potato is a carbonaceous food, containing as it does 21 per cent. of carbohydrates. It has the smallest water content of all "roots," and therefore its feeding-value is higher than any other root crop. Potatoes make a very satisfactory feed, but dairy cows should not receive more than 20 lb. per day. Potatoes are very liable to cause digestive troubles; the starch-grains are very large, and this makes them difficult of digestion when raw, except to herbivora—for example, dairy cattle. When potato feeding to any stock commences, the potatoes should be introduced gradually into the ration. Cooked potatoes are an excellent food for pigs, especially finishing pigs; they should never be fed raw, or digestive troubles are sure to follow. When comparing potatoes with meal in pig-feeding, 4 lb. of potatoes should be regarded as being equal to 1 lb. of barley-meal. With dairy cattle 6 lb. of raw potatoes is equal in feeding-value to 1 lb. of mixed meal. Old sprouted potatoes should have the sprouts removed before feeding, as poisoning may result from a substance called solanin. In Germany dried potatoes are held to be as valuable for the feeding of horses as oats.

Artichokes.—Jerusalem artichokes are the common winter feed for pigs; they are rarely fed to cattle or horses. Although so frequently made the sole feed for pigs, the reason these animals do not thrive so well on them alone is that they contain too little protein for a pig's requirements. Some other food must be added to provide this for successful rearing. The large stems and leaves of the artichoke, if cut off above ground, make excellent green feed for sheep, young cattle, and even dairy cows. If cut when 6 ft. high, the yield of tubers is not appreciably affected. The great feeding-value placed upon artichokes should be taken with reserve.

(To be continued.)

CHEAP SEED-MIXTURES: A WARNING.

PURCHASERS of seed for bush burns and hill country are advised against the buying of "cheap" mixtures as advertised throughout the Dominion, without first ascertaining whether they are really worth the attractive prices asked. Several analyses made on behalf of prospective buyers have shown that the mixtures in all cases are worth approximately only one-half of the price asked, and that a mixture of good-quality seeds in the same proportions could be bought for about 1d. per pound more than is asked for the inferior seed. Samples of advertised cheap seed are being obtained from various sources, and the results of analyses will be published in the *Journal.*

—N. R. Foy, Seed Analyst, Biological Laboratory, Wellington.

THE GRASS-SEED INDUSTRY IN SOUTHLAND.

N. R Foy, Seed Analyst, Biological Laboratory, Wellington, and R. McGillivray, Instructor in Agriculture, Invercargill.

The New Zealand grass- and clover-seed industry is centred mainly in the South Island, wherein it is divided into several groups, the two largest being Canterbury and Southland, where this line of production takes an important place in farming practice. Southland is mainly a grass-seed producing centre, only a comparatively small quantity of clover-seed being saved. The rye-grasses (perennial and Italian), Chewings fescue, and crested dogstail are the species produced in greatest quantity, while brown-top, Lotus major, and wild white clover are saved in appreciable amounts.

The history of the grass-seed industry in Southland goes back to the early "nineties," when considerable quantities of rye-grass seed passed through the stores. At the present time what was then regarded as a side-line has developed into an organized industry, with extensive machining plants at Gore and Invercargill. Approximately 30 per cent. of the New Zealand acreage under seed crops belongs to Southland, and the province produces 30 to 35 per cent. (approximately 4,500 tons) of the total New Zealand output.

RYE-GRASSES.

In the 1926-27 season in Southland 42,082 acres were under rye-grass for seed, the production being 3,028 tons, or nearly 40 per cent. of the Dominion total. Perennial rye-grass is a most important species in Southland, and under the better pasture-management of to-day much of the richer land of the province is carrying first-class swards of it which are improving with the increase in fertility following on top-dressing.

In the past the local demand for seed has been extensive, but with the increasing permanency of pastures this local requirement has diminished, and more seed has been available for distribution to the North Island and for export. It is upon the export demand that the industry depends for its development, and growers may rest assured that this demand is dependent to a large extent on the quality of the product. The principal overseas buyers are Australia, Great Britain, and the United States of America.

CHEWINGS FESCUE.

The production of Chewings fescue is almost wholly confined to Southland, where in the 1926-27 season 9,108 acres produced more than 940 tons of seed. Chewings fescue was introduced into Southland in the late "seventies," and was grown by a Mr. Tarlton near Invercargill. The seed saved was taken by him and sown on a farm at Mossburn, which district, together with the Waimea Plains, has become the centre of the production area. The Mossburn property was later purchased by the late Mr. George Chewings, who was responsible for the initial commercializing of the seed.

The New Zealand requirement for this seed is now small, and practically the whole of the output is available for export. In 1926

nearly 700 tons was exported, over half being absorbed by the United States, where it is in great demand for lawns and golf-links turfing purposes. The value of this trade in 1926 was estimated at £61,500.

Some of the Chewings fescue is put down with rye-grass, but although this may be advantageous from a grazing point of view it is not to the best advantage for seed-cropping, as the rye-grass seriously affects the purity of the fescue. The more common practice is to sow the fescue alone at about 12 lb. to 14 lb. per acre. The pasture is grazed in the first season and seeded in the second, this being followed by a second grazing until August, when the areas are rejuvenated by skim-ploughing. In some localities up to seven and eight crops are taken off before skim-ploughing, but this is inadvisable, as the plants lose vitality, to the detriment of the seed crop. Under the best conditions the maiden crops should be limited to three.

Top-dressing is now carried out on many areas with beneficial results, both from a grazing and seed-production viewpoint. Experience has demonstrated that the greater the vitality shown by the plants the higher will be the vitality of the seed produced. Chewings fescue is a delicate seed and quickly affected by adverse conditions; therefore lines with a high vitality are more easily able to withstand unsuitable storage conditions, &c. It is thus very advisable that growers should produce a thoroughly matured seed from strong-growing plants. Maturity is intimately associated with vitality in all seeds, and the more mature the seed is allowed to become before it is removed from the parent plant the greater are its storage capabilities, weight, and general quality.

CRESTED DOGSTAIL.

In the 1926–27 season Southland produced approximately 520 tons, or 80 per cent., of the New Zealand output of dogstail. The principal areas of production are in the Gore district, but nearly all parts of the province grow dogstail in varying amounts. A small proportion of the seed is saved from permanent pasture, but the bulk is taken off areas specially sown at the rate of 14 lb. to 18 lb. per acre. As is the case with rye-grass and Chewings fescue, the crop is usually cut with the reaper-and-binder, but the stripper is used to some extent, especially on sheep-pastures.

The Dominion requirements for dogstail-seed are considerable, but there is also a considerable surplus for export, which is absorbed mainly by Britain. In 1926 over 100 tons, valued at £20,000, was exported. Like Chewings fescue, crested-dogstail seed suffers from a deterioration in germination during shipment overseas. This, it is held, is due to low vitality of the seed following incomplete maturity or production from weakened plants; and seed of a poor vitality is unable to withstand the extremely unsuitable storage conditions existing in most cargo-holds. The trouble has been remedied to some extent by the growers allowing the crop to stand as long as possible before harvesting, so that the seed may almost fully mature. The light-golden colour of the seed, so popular with Southern growers and merchants, is a sure indication of immaturity, and the aim of the grower should be the dark-bronzy colour of thoroughly ripe dogstail. Unlike rye-grass, which requires a hot, dry harvest, dogstail and Chewings

fescue both benefit from cooler moist conditions prior and subsequently to cutting, so that the seed may be prevented from rushing to an apparent ripeness before it is properly matured.

BROWN-TOP.

Southland has only recently taken up brown-top seed production, which until a few years ago was confined to the Waipu district of Auckland Province. There are many areas of pure brown-top in Southland where, until the specific identity of the grass was known, it was allowed to seed and go to waste. Previously known locally as couch and twitch, brown-top is now systematically seeded in quantity, a very fine quality seed being produced. All seed is fully dressed, and compares more than favourably—from a germination and purity viewpoint particularly—with the brown-top from any other district. Considerable quantities are absorbed within the Dominion, and in 1926 approximately 25 tons, valued at £7,000, was exported, mainly to the United States.

Brown-top is harvested in the same manner as other grasses. Some growers cut the crop far too early, in which case the seed is practically useless. The ripening crop is deceptive, appearing ripe when far from it. For harvesting, the plants should be nearly dry, and the seed not quite on the point of loosening in the glume.

WHITE CLOVER.

It is only of recent years that white clover has been seeded in any quantity in Southland. Last season 185 acres were devoted to this crop, 21,160 lb. of seed being produced. The Southland seed is taken mainly off permanent pasture, and is usually of the wild white type. With the more extensive use of lime and artificial fertilizers the clover content of pastures in the province is increasing, and there will be no doubt an increasing amount of seed saved. The success of the New Zealand white clover seed trade is dependent upon an export demand, which demand should increase materially with the introduction of a system of crop inspection and certification of genuine old pasture types.

LOTUS MAJOR.

A fair amount of Lotus major is produced in the province. The seed, mainly in the Mokoreta and Waiau districts, is usually of splendid quality and entirely free from other species of Lotus. Some growers appear to cut well on the green side, as is evidenced by the high percentage of brown shrivelled seeds in a few lines. The quantity placed on the market would be about 8 to 10 tons.

TIMOTHY.

A small quantity of timothy-seed of splendid quality is saved by one or two growers. It is regrettable that there is not more produced, so that our annual importation of approximately 100 tons might be reduced.

COCKSFOOT.

Cocksfoot is very widely distributed in Southland, but the acreage actually set aside for seeding is small, and the total amount of seed

saved runs from 30,000 lb. to 40,000 lb. annually. Unlike that of several other districts in New Zealand, the local cocksfoot-seed does not seem to be looked upon with much favour. Our annual importation of some 800 tons of cocksfoot could be reduced by at least 100 tons were much of the wasting cocksfoot saved throughout the Dominion. There are many obviously valuable close leafy strains in the Southland pastures which doubtless could be propagated with advantage, but until the value of the different strains is actually demonstrated and appreciated the locally grown seed is not likely to be in marked demand.

THE COMMERCIAL ASPECT.

From a commercial aspect Southland is one of the most important seed-production districts in New Zealand, and a large amount of capital has been expended in stores and machine-cleaning plants. Seed is purchased by merchants as farmers' dressed direct from the mill, or it is dressed at so-much per pound on behalf of the grower, who then offers it as M/D, or machine-dressed. In either case a sample is submitted for test, so that the buyer can fully assess and place a value on a line under offer.

The importance of purity and germination is becoming better recognized, and these factors are now relied upon to a greater extent than are the older quality-factors—weight and colour. These, of course, cannot be ignored, but they are secondary to the purity and germination factors. That the importance of these tests is recognized is shown by the fact that during 1927 over 30 per cent. (3,377) of the samples received at the official Seed-testing Station came from Southland.

FUMIGATION OF VINERIES WITH CALCIUM CYANIDE.

J. C. Woodfin, Vine and Wine Instructor, Horticulture Division.

Calcium cyanide is fast taking a leading position as a destructor of vermin and insect pests. As a means of controlling mealy bug in vineries it is more simple, less dangerous, and quite as efficacious as the old pot method of cyaniding. Before attempting to use this remedy the operator must realize that he is dealing with a very deadly gas, the inhalation of which will cause death. However, there should be no serious danger if reasonable precautions are taken.

So far as the vines are concerned, there is a risk of burning the foliage and grapes when the latter are in their green stage, and grape-growing authorities in England now advise the use of cyanide only after the grapes have been cut. Notwithstanding this sound advice, it sometimes happens that the mealy bugs—the pest we have to deal with here—are very much in evidence when the grapes are green, and threaten to ruin their market value. Under such circumstances a grower can afford to take some risk in order to obtain a clean and profitable crop.

DOSAGE.

The exact quantities which will at the same time exterminate the mealy bug without danger to the crop must be ascertained by the grower himself, by working up gradually to a dose which proves sufficiently strong to kill the insects and weak enough to avoid burning the tender foliage and green grapes. The most effective quantities will be found to differ considerably on account of the variation of gastightness of the houses, which should be rendered as tight as possible.

In the green stage $\frac{1}{2}$ oz. per 1,000 cubic ft. might be tried to start with, and when the grapes are beginning to colour—a much safer period—$\frac{3}{4}$ oz. is better. When the grapes have been picked 4 oz. per 1,000 cubic ft. can be used. These amounts will probably have to be increased, as many of the houses are far from gastight, a condition which renders the use of cyanide in vineries attached to or near dwellings a dangerous practice.

In every case a second fumigation after a period of about twelve days is necessary to kill the insects which may hatch out in the interval, as the gas does not apparently affect the eggs.

CONDITIONS AND APPLICATION.

Fumigation should be started one hour after sunset, and the house opened up in the morning before the sun strikes the vinery. Strong light combined with cyanide-gas causes burning of the foliage. The foliage should be dry, as moisture takes up the gas and the dilute acid causes burning. The soil of the vinery should be only slightly damp, and no standing water should be left in the house, as this would absorb the gas and weaken the dose. If the soil is dry, it can be watered not later than twenty-four hours before fumigation. The temperature should not be above 70° or below 55° F. A calm night is necessary for successful fumigation, as strong winds are apt to increase the leakage of gas.

Put the required quantity of calcium cyanide in a wide-mouthed jar, or, in the case of a long house, in several jars placed at intervals, and, walking from the closed end of the vinery, scatter the contents evenly over the soil; then close and lock the doors, placing a warning notice on them. As the gas is given off slowly from the calcium cyanide, there is ample time to scatter the chemical, without danger, at an ordinary walking-pace. The gas will have practically disappeared by the following morning.

To calculate the amount of calcium cyanide required measure the body of the house, which may be, say, 80 ft. long, 25 ft. wide, and 4 ft. high, which works out at 8,000 cubic ft. Then measure the top part of the house, taking a vertical line to the apex from a line drawn from top-plate to top-plate—say, 8 ft.—of which take half and multiply the square of the body by it: $80 \times 25 \times 4 = 8{,}000$ cubic ft. Then the total cubic contents of the house—8,000 plus 8,000 cubic ft.—equal 16,000 cubic ft.

Correction.—Referring to the list of imported grape-vines published in last month's *Journal* (page 107), the abbreviation "E" given at the head and used in the list stood for "a week *earlier* than 1"—not "later," as printed.

PREVENTION OF SAP-STAIN IN WHITE-PINE.

TESTS BY STATE FOREST SERVICE.

C. E. DIXON, Forest Assistant, State Forest Service, Wellington.

(Concluded.)

TABLE 2 shows that none of the representative boards in the close-stacked treated pile showed stain until six weeks after the formation of the stack, when one of the boards was found to be lightly stained. During the next fortnight, however, the remaining representative boards all developed light stain, and from then on until the dismantling of the stack the increase in stain was very slight. The final examination, however, as shown in Table 5, revealed that 35·8 per cent. of the boards were blotched and 48·5 spotted. It was noticed that the boards in the top three layers were all badly stained, and this was probably due to the treating-solution having been washed off by the rain, thus reducing the treated material to the same conditions as experienced in the untreated stack, and making it very liable to attack. A proportion of 9·3 per cent. of the boards was entirely free from stain, and it appears that, had the stack been formed under cover, the staining would not have been severe. The depth of staining in this stack often occurred up to ½ in. in depth. Fig. 6 represents typical staining in the pile.

Table 2.—Occurrence of Sap-stain in Close-stacked Treated Pile.

(Five boards examined.)

Date.	Sap-stain Occurrence.
1927.	
2nd April ..	Stack formed.
9th April ..	Staining, nil.
16th April ..	,,
23rd April ..	,,
30th April ..	,,
7th May ..	,,
14th May ..	One board slightly spotted.
21st May ..	No increase in stain; timber still of good appearance; two boards lightly stained.
28th May ..	Four boards stained (one board unable to be removed), the stain appearing in streaks and blotches.
2nd July ..	No increase in stain.
30th July ..	Slight increase.
27th August ..	No increase.
24th September	,,
27th October ..	Very slight increase.

NOTE.—Overhanging ends of boards commenced to show staining on 16th April.

The history of the staining in the open-stacked untreated pile is shown in Table 3. Two of the representative boards had become

FIG. 6. TYPICAL STREAKED STAINING OCCURRING IN CLOSE-PILED TREATED STACK.

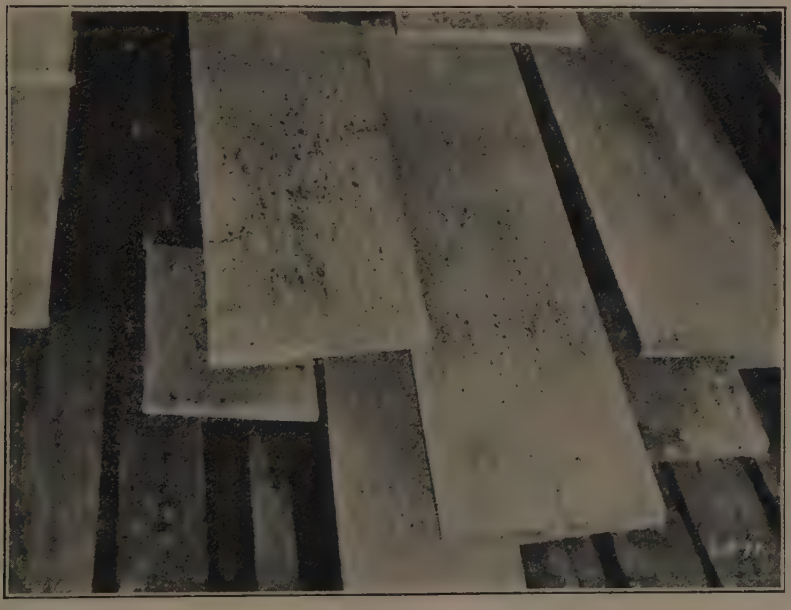

FIG. 7. OVERHANGING ENDS OF TIMBER BADLY SAP-STAINED.

Box-stacking overcomes this, due to the free ends of the timber occurring in centre of stack.

lightly spotted on both sides one week after the formation of the stack. The staining continued steadily for the next five weeks, at the end of which period four representative boards were lightly spotted and six boards heavily spotted on both sides. From then onwards until the dismantling of the stack, four months later, the staining showed but little increase. The final examination, as shown in Table 5, proved that the majority of the timber was still in very good condition, and that only 13·6 per cent. of the boards had been heavily spotted. The percentage of unstained timber was high, being 34·9 per cent., while lightly spotted timber, which would not degrade the timber at all, represented another 25·2 per cent. In all cases in this stack the maximum depth of the stain was less than $\frac{1}{16}$ in., and could be planed off with very little loss.

Table 3.—Occurrence of Sap-stain in Open-stacked Untreated Pile.

(Ten boards examined.)

Date.	Sap-stain Occurrence.
1927.	
1st April ..	Stack formed.
9th April ..	Two boards lightly spotted on both sides.
16th April ..	Three boards lightly spotted; two boards thickly spotted on both sides.
23rd April ..	Six boards lightly spotted; two boards thickly spotted on both sides.
30th April ..	Six boards lightly spotted; three boards thickly spotted on both sides.
7th May ..	Five boards lightly spotted; five boards thickly spotted on both sides.
14th May ..	Four boards lightly spotted; six boards thickly spotted on both sides.
21st May ..	Slight increase in spotting.
28th May ..	Practically no increase in staining.
2nd July ..	No increase in stain.
30th July ..	,,
27th August ..	,,
24th September	,,
27th October ..	Slight increase in stain.

NOTE.—Stack sap-stained, but not so badly as the close-stacked untreated pile.

Table 4, which represents the condition of the representative boards in the open-piled treated stack, indicates that though a light staining appeared after six weeks there was no further increase in the stain during the whole period the timber was stacked. Reference to Table 5, representing the final detailed inspection, shows that 54 per cent. of the boards were unstained, 34·1 per cent. lightly stained, while only 4·6 per cent. exhibited heavy stain. In all cases it was proved that the stain was purely on the surface and had no measurable depth. It was also found that only top and edge boards were stained at all, and as these were subjected from time to time to heavy rain it is reasonable

to conclude that staining occurred only where the treating-solution had been washed off the boards. Boards in the interior of the stack were entirely free from stain.

Table 4.—Occurrence of Sap-stain in Open-piled Treated Stack.

(Ten boards examined.)

Date.	Sap-stain Occurrence.
1927.	
6th April ..	Stack formed.
16th April ..	Staining, nil.
23rd April ..	,,
30th April ..	,,
7th May ..	,,
14th May ..	,,
21st May ..	Two boards lightly spotted.
28th May ..	Only one board entirely free from stain; the stain on other boards very slight.
2nd July ..	No increase in stain.
30th July ..	Slight increase.
27th August ..	Very slight increase.
24th September	No increase.
27th October ..	Very slight increase.

A general examination of the four stacks indicated that the tendency is for spotting to occur on the exposed surfaces and blotching on the more sheltered surfaces. This is borne out by experience of timber stacked in any mill-yard. It is always noticed that the overhanging ends in the stacks are sap-stained in the form of spots. Blotches never occur in these cases. This also explains the freedom from blotches exhibited by both open-piled stacks. In these there were no sheltered surfaces, and, as a consequence, no blotches. In the close-stacked material, in which the surfaces of the various boards were in direct contact, blotching occurred very badly, and it is probable that the blotches developed from groups of spots which combined under conditions suitable for their growth into one large area. (Table 5, next page.)

In order to show clearly the effect of treating and open piling of the timber Table 6 was prepared. An examination of this table proves conclusively the great value of both the borax dip and the open piling of timber as a preventive of sap-stain. In the close-stacked untreated pile the percentage of unstained and lightly stained boards is as low as 19·3, with the moderately and heavily stained percentage as high as 80·7. The effect of open stacking and treating the timber is shown as a complete reversal of these figures, in that the percentage of unstained and lightly stained timber is now 88·1, while that of moderately and heavily stained timber is only 11·9. The other columns in the table show that both borax dipping of close-stacked timber and open piling of untreated timber are separately responsible for saving approximately 40 per cent. of the timber.

Table 5.—Results of the Final Inspection expressed as Percentages of the Total Number of Boards in each Stack.

Description.		Close-piled Untreated Stack.	Close-piled Treated Stack.	Open-piled Untreated Stack.	Open-piled Treated Stack.
Boards streaked ..	Lightly ..	0	1·4	0	0
	Moderately	0	5·0	0	0
	Heavily ..	0·7	0	0	0
Boards spotted ..	Lightly ..	9·3	34·3	22·0	3·0
	Moderately	13·6	7·1	19·2	0
	Heavily ..	7·1	7·1	10·6	1·9
Boards blotched ..	Lightly ..	9·3	12·9	3·2	31·1
	Moderately	32·8	17·9	7·1	7·3
	Heavily ..	26·5	5·0	3·0	2·7
Boards free from stain		0·7	9·3	34·9	54·0

Table 6.—Results of Final Inspection expressed as Percentages of the Total Number of Boards in each Stack. (Condensed from Table 5.)

Description.	Close-piled Untreated Stack.	Close-piled Treated Stack.	Open-piled Untreated Stack.	Open-piled Treated Stack.
Boards free from stain and lightly stained	19·3	57·9	60·1	88·1
Boards moderately and heavily stained	80·7	42·1	39·9	11·9

In all stacks, even the treated, the top two or three layers of boards were sap-stained. This was due in all cases of the treated timber to the washing-off of the solution by rain, and it is probable that the only way this could be overcome would be by roofing the stacks. This could be done cheaply at the mill by manufacturing temporary roofs from second-class boards by battening them together, and the protection of the timber from not only staining but checking would easily repay the cost. Fig. 9 shows boards from the top of the open-piled treated stack which had been badly sap-stained due to the washing-off of the solution by rain.

Cost and Application of the Treatment.

In the present study 36 lb. of borax, at a total cost of 14s., was used to treat 5,500 ft. B.M. of timber. After treatment it was found there was sufficient solution left to treat a further 10,000 ft. B.M., and on this basis the cost of the preservative is approximately 1d. per 100 ft. B.M. of timber treated. The tank and draining-platform, which would be constructed of timber at the mill, could be manufactured for approximately £10.

In small mills (cutting under 5,000 ft. B.M. per day) it would be quite possible and practicable for the yardman to attend to the dipping and draining of the timber as it came off the saw, thus reducing overhead and handling costs. In medium or large-sized mills, however, very probably an extra man would be required to carry out the treatment, thus increasing the cost by approximately 1d. to 2d. per 100 ft. B.M., depending on the size of the mill.

In large mechanized mills special apparatus could conveniently be installed. Two methods of dipping are practised. In the first the timber is forced under the surface of the solution by large wheels, while in the second the boards are allowed to drop into the solution and are hauled up the other side by means of travelling chains. These are the types of apparatus used in the southern United States of America, where dipping to prevent sap-stain is extensively carried out. No extra labour would be necessary to operate these plants, and the depreciation and power costs would amount to approximately 1d. per 100 ft. B.M.

The total cost of treating the timber will thus vary from 2d. to 3d. per 100 ft. B.M., depending on the methods of carrying out the operation.

FIG. 8. SAP-STAIN OCCURRING ON TOP BOARDS STACKED IN OPEN-FILLETED TREATED PILE.

Rain has washed off the treatment, allowing sap-staining fungi access to timber. Roofing of stacks would prevent this.

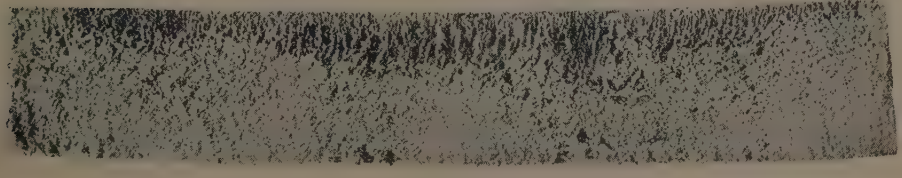

FIG. 9. TYPICAL DEPTH OF SAP-STAIN OCCURRING IN CLOSE-STACKED UNTREATED PILE.

Conclusions.

The results of the foregoing study may be summarized as follows :—

(1) There is no cure for sap-stain; it must be prevented.

(2) Sap-stain attack may be retarded and almost eliminated by (*a*) dipping the timber in a borax bath, and (*b*) piling the timber in an approved fashion.

(3) Neither 2 (*a*) nor 2 (*b*) is in itself sufficient to prevent sap-stain attack. Both operations must be carried out in conjunction.

(4) The most efficient style of piling to adopt is the open-filleted box type. Open filleting prevents accumulation of moisture on the wood, while the box design leaves no overhanging ends on the stack. When stacks have overhanging ends these invariably become sap-stained

(5) Roofing of treated stacks is essential, in order to prevent the treatment being washed off by seasonal rains.

(6) Under no circumstances should the timber be left in a block-stacked condition for more than a few hours. In this condition the attack commences very quickly, and will continue despite precautions taken later.

Recommendations for Prevention of Sap-stain.

Having consideration to the various factors involved, the Forest Service recommends the treating of all white-pine sapwood immediately it comes off the saw, followed by stacking in approved fashion, whenever it is necessary to season the timber before it goes into actual use. This applies only, of course, to timbers used for purposes for which sap-stain is a defect.

The treatment consists of momentarily dipping the timber in a saturated solution of borax in water (2 per cent. at normal temperature). The piling recommended is the open-filleted box type. In this the stack is made up in the form of a box, two boards being used throughout the length of the pile, with their free ends occurring on the inside of the stack. The fillets should be not less than 2 in. wide by 1 in. thick, and should be spaced not more than 4 ft. apart. A 6 in. air-chimney should be provided at 2 ft. intervals in the width of the stack. Where possible the stack should be roofed over, the roof overhanging at least 1 ft around the stack. A section of the stack is shown in Fig. 3.

ACKNOWLEDGMENTS.

The following organizations have co-operated with the Forest Service in the work here described : Dairy Division, Department of Agriculture —general ; Diggers Sawmilling Co., Woodstock—land and facilities for carrying out the tests. Mr. W. C. Ward, of the Forest Service, co-operated in the presentation of the study.

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(1) " The Control of Sap-stain, Mold, and Incipient Decay in Green Wood, with Special Reference to Vehicle Stock," by Nathaniel O. Howard, Pathologist, United States Department of Agriculture.

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WEEDS AND THEIR IDENTIFICATION.

(Continued.)

ESMOND ATKINSON, Biological Laboratory, Wellington.

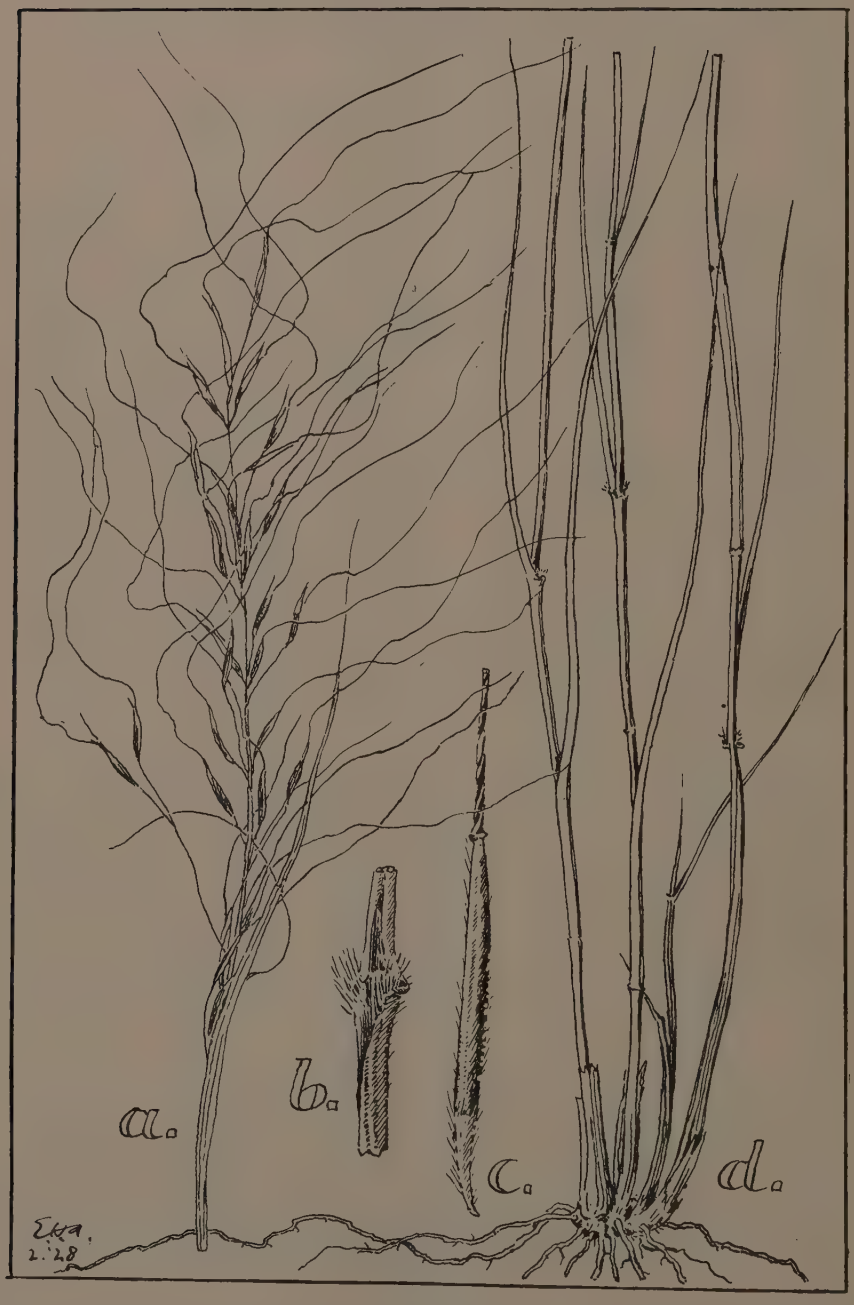
SPEAR-GRASS (*STIPA SETACEA*).

THE grass illustrated in this article has been known in New Zealand for fifty years or more. It was first discovered in Otago, and was then thought to be an undescribed native species, being given the name of *Stipa Petriei*.* Only after some time—when it had begun to spread considerably and showed unmistakable signs of being an introduced plant—was it found to be the same as the Australian *Stipa setacea*. Cheeseman ("Manual of the New Zealand Flora," 1906, p. 858) describes spear-grass under this name, but, while including it among the indigenous grasses, remarks: "A common Australian plant, stretching from Queensland to Tasmania. It is probably naturalized only in New Zealand." In the Appendix he says: "I have received numerous specimens of this plant from various localities on the east coast of the South Island from Marlborough to Otago. It is evidently spreading rapidly, and no doubt can be entertained of its exotic origin." In the second edition, of 1925, however, it is still included among the native species. Little has been heard of spear-grass as a weed in New Zealand (though in Australia it has proved troublesome from time to time) until within the last few years, when it has spread rapidly on Banks Peninsula and in the Marlborough Sounds. Lately there have been a good many inquiries about it at this Laboratory, on account of its danger in sheep-country.

Spear-grass is a striking plant when in flower, owing to the graceful, open head, with its unusually long awns. (The awn is the bristle-like attachment to the scale which forms part of the covering of the so-called "seed" in grasses.) Fig. *a* of the illustration shows the general appearance of a head, but larger ones than this, with many more flowers, are often seen. The whole grass is slender and wiry-looking (Fig. *d*), even the leaves being so, owing to their inturned edges. Fig. *b* shows (magnified) the junction of leaf and leaf-sheath with its tufts of hairs. At Fig. *c* (also magnified) is shown the "seed," sharply pointed at the lower part, and at the opposite end the base of the awn, which is spirally twisted.

It is these sharp-pointed "seeds," with their long twisted awns, that make spear-grass so troublesome a weed under certain conditions. The following quotation from Hilgendorf's "Weeds of New Zealand" (p. 27) gives a very clear idea of the actual damage done: "Each seed has a very sharp spike, and the twisted awn helps to drive this spike into sheep's wool. The seed sometimes penetrates the pelt, and embeds itself in the subcutaneous muscle, entirely spoiling the appearance of the carcase. An area of 3 square inches of the surface muscle of a sheep killed at Picton works was found to contain thirty-three seeds of spear-grass. The tails had broken off as the seed had passed through the skin, and only the heads were embedded in the muscle. The pain, and consequent loss of condition, to the sheep must have been

* Buchanan: "New Zealand Grasses," Plate 17, ii.



SPEAR-GRASS.

(*a*) Flowering head, natural size; (*b*) junction of leaf and sheath, showing tuft of hairs, enlarged; (*c*) seed, showing twisted base of awn, enlarged; (*d*) small piece of tussock, natural size.

[*Drawing by Esmond Atkinson.*

very serious. It appears that only occasionally does the seed ripen hard enough to act in this manner, because in some cases where spear-grass is found the sheep are not affected."

This article is written primarily with the idea of showing what spear-grass is like to look at, so that where it has only recently made its appearance there may be no delay in recognizing it. It is too early as yet to formulate any definite rule for combating the weed, but the owners of country where spear-grass is spreading are likely to have noticed many points about its behaviour under varying conditions. The possession of such facts from a wide range of country would, when they were correlated, certainly be of great value in dealing with a weed like spear-grass, and any information sent in to the Department of Agriculture would be appreciated.

SO-CALLED BLACK LOGANBERRY: A WARNING.

A PLANT known as "black loganberry" has been raised and distributed by at least one nursery firm in New Zealand, with the idea that something in advance of the common loganberry had been secured. Doubtless this was done in good faith, but the firm chiefly concerned, as well as other persons who have had experience with the plant as a commercial proposition, now realize that to continue with it means trouble for the future, without expectation of any reasonable present recompense. The plant not only fails to set fruit satisfactorily, but has the spreading propensities of blackberry, and is almost as difficult to eradicate. This note of warning is therefore issued for the information of any would-be growers.—*J. A. Campbell, Director, Horticulture Division.*

IRRIGATION STATISTICS.

THE collection of particulars relative to irrigated land in New Zealand was introduced in the 1925–26 season, and the figures are now published for the first time, together with those for the succeeding season. It will be seen that the total area irrigated increased by 8,951 acres, this being accounted for by an almost corresponding increase in the area of irrigated pasture land. A comparison of both years is given in the following table:—

Irrigated Land and Crops.	Area irrigated.	
	1925–26.	1926–27.
	Acres.	Acres.
Orchards	2,066	2,027
Green fodder and root crops	1,840	2,273
Pasture	42,380	49,942
Lucerne	784	2,165
Oat	778	428
Wheat	62	65
Barley	17	58
Market gardens	74	29
Other crops	81	46
Totals	48,082	57,033

—*Census and Statistics Office.*

SEASONAL NOTES.

THE FARM.

AUTUMN- AND WINTER-SOWN CEREALS.

In the South Island the period for sowing autumn and winter cereals extends from the end of April to about the middle of June. Oats are usually sown from the end of April to the end of May, and wheat during May and the early part of June. Sowing in July is generally avoided. Spring sowing takes place in August and September, the cereal usually following turnips fed off in the winter. The extended period in which cereals are sown allows an even distribution of team labour over the autumn, winter, and spring months; it extends the period of harvesting from early January to the end of February, and thus allows the crops to be harvested without any undue rush. Also, the autumn-sown cereals provide valuable feed in the spring for breeding-ewes, after the turnips are finished and before the spring growth of grass starts.

In the North Island and the far south of the South Island cereals are generally spring-sown; in both areas the cereal crop usually follows turnips. In the North Island autumn-sown cereals generally run too much to straw, are liable to rust, and, ripening early, they require harvesting during the haymaking-period, which congests the farm-work at that time. In the far south the low winter temperatures render it inadvisable to sow in the autumn.

Wheat.

The main wheat-growing areas of New Zealand are situated on the plains and rolling downs of Canterbury and North Otago. The soils best suited to the growth of wheat are those of the heavier description, such as well-drained clay soils. The average wheat-growing soil of Canterbury is a good, free-working loam overlying a clay subsoil, but the best yields are usually obtained from the leavy loams.

Place in rotation: Autumn- and winter-sown wheat can be taken after grass or clover, rape, cereal, peas, potatoes, and linseed. The crop usually does best after clover or rape; if taken after grass the land should be skimmed early to allow the sod to rot before the wheat is sown. Good crops are often obtained after potatoes, provided sowing is not unduly late. Wheat is often taken after wheat or oats, with quite good results on strong land, but the second crop should be well manured.

Cultivation: Wheat requires a fine, firm seed-bed—the fine soil at the bottom and the clods at the top. Small lumps on the surface of a field of autumn-sown wheat are no disadvantage; the clods break down in the winter and provide a loose surface, preventing the land from caking hard in the early spring. Grassland intended for wheat should be skim-ploughed any time between the end of November and the middle of March. After lying for about six weeks the surface should be disked and the land cross-ploughed 6 in. or 7 in. deep. The surface can then be levelled with the harrows, and the final tilth given

with the disks and harrows. The cultivator should not be used, as it is inclined to drag any undecayed vegetation to the surface. The two ploughings of grassland for wheat are very necessary, in order to allow the vegetation to decay and to obtain a fine, firm seed-bed. Early skim-ploughing gives virtually a summer fallow, and allows the land to absorb the autumn rains. Land after peas, rape, linseed, or a cereal can be worked down after ploughing with the harrows, disks, and cultivator. The cultivator is a necessary implement when the land is cloddy, as it brings the clods to the surface and shakes the fine soil to the bottom, thus making a good seed-bed for the crop. Care should be exercised in the use of the roller on wheat-land for breaking clods, as it is liable to consolidate the surface and cause it to set. If the roller is used it should be followed with the cultivator to loosen the surface again.

Manuring: The crop should be manured with 1 cwt. of superphosphate or basic super. Although recent experiments have shown that this quantity of fertilizer will give increased yields of up to 4 or 5 bushels per acre, a very large area of wheat is, unfortunately, annually sown without any manure.

Varieties: The common varieties of wheat sown in New Zealand wheat-growing areas are Solid-straw Tuscan, Hunter's, and Velvet Chaff Pearl. Solid-straw Tuscan is the best wheat for windy districts, as the straw is filled with pith and is very rigid, so that it does not thresh about in the wind. Hunter's is a popular variety for medium wheat-growing soils; it yields well, produces a large amount of green feed, and can be fed off fairly close. Velvet Chaff Pearl is a wheat of very high milling-quality, but is only grown on medium land of even quality where the whole crop will ripen at once, as the grain is loose in the chaff and liable to shake.

Seeding: For autumn and winter sowing the seeding varies from 1¼ to 1½ bushels. The seed should be pickled for stinking-smut before sowing. The common practice is to use the formalin pickle on the farms, but a good deal of seed is now treated in bulk with copper carbonate. The latter method consists in dry-dusting very finely divided copper carbonate on to the wheat at the rate of 2 oz. per bushel. As the powder is poisonous if breathed in quantity, the dusting is usually done in a closed rotating cylinder. The advantages of this method are that large quantities of seed can be treated by machinery at seed-cleaning plants, the seed may be treated any time before sowing, and the germination is in no way injured.

Drainage: Wheat will not stand flooding to any extent in the winter-time. Any hollows in the wheatfields should have surface drains made from them to carry off any standing water that may collect after rain.

Oats and Barley.

Autumn oats usually follow a cereal or an early fed-off fodder crop. The seed-bed requirements are similar to those already mentioned for the wheat crop. Algerians for chaff and Gartons for grain are the common varieties sown in the autumn. Both varieties produce very palatable green feed in the spring; Algerians can be fed off with the greatest severity, but Gartons should be quickly eaten down once and then left alone. The autumn seeding is 1½ to 2 bushels, and the

crop, especially if taken on stubble land, should receive 1 cwt. per acre of super or basic super.

On North Island dairy farms oats are sometimes grown as a catch-crop for spring green feed. This season root crops have either failed altogether or have only done moderately well, and feed will probably be scarce in the winter and early spring. Any vacant land could with advantage be sown in Algerian oats for spring feeding, and the crop followed with root and forage crops later in the year. Although the yield of green oats is not particularly high, the crop is of very high feeding-value and is excellent for milk-production. For green feed sow 2 bushels of Algerian oats with 2 cwt. of super per acre. Barley is sometimes used for spring green feed, but it does not yield as well as oats, nor is it as palatable; barley if fed when running up to seed causes digestive troubles in cows, and cows are frequently poisoned feeding off partly matured barley.

Barley for malting is sometimes sown in the autumn, but care must be taken that the land selected is perfectly dry in the winter, as barley is killed out if the land is subject to winter flooding.

TOP-DRESSING OF PASTURES.

Top-dressing in April and May increases the winter growth of grass. This year pastures in most dairying districts have suffered severely during the dry weather, and will require careful handling to get them back into good condition. Bare spaces in pastures, unless they can be covered with a clover growth, will eventually grow weeds, and the sooner the top-dressing is put on the better chance white clover has of gaining supremacy. White clover shades the surface of the ground and allows the stunted grass-plants to root again and start growth.

Superphosphate is the best fertilizer for autumn top-dressing, as it is quick in action and forces the grass and clover along while the soil-conditions are still suitable for growth. The quantity to be applied depends on whether the pastures are top-dressed once or twice a year. If only once, then 3 cwt. should be applied; but if twice, 2 cwt. in the autumn and 2 cwt. again in the spring are the usual quantities. Autumn is the best period for dealing with top-dressing work on hill country, as it allows the best use to be made of fine weather. Later, when the hills become wet and slippery, great difficulty is often experienced in getting the material on to the ground, and the cost of applying is materially increased.

—P. W. Smallfield, B.Ag., Instructor in Agriculture, Ruakura.

THE ORCHARD.

EXPORT WORK.

In picking all varieties for export two main essentials have to be kept prominently under observation—namely, colour requirements and stage of maturity. Neither should be sacrificed for the other in any instance. Every effort should be made to get the fruit picked at the right stage, and despatched as soon as possible after it is picked. Allowing fruit to remain in the shed—either before or after packing—is detrimental, and detracts from general appearance.

Careful handling of fruit for export may still be emphasized, there being signs of damage in many lines now coming forward for examination. Attention must be called to the possible damage to apples at the sides of the cases when packing with the high bulge recommended this season. Much of this can be alleviated by a slight pressure of the apples towards the centre of the case before putting the lid on. Apples packed high at the ends of the case are very liable to be bruised. A good practice is to pack the first few apples in the case—or even half the tier—with the calyx towards the packer, reversing this at the other end. This applies more to apples slightly conical in shape. The result will be a solid pack in the centre of the case, with very little chance of sinking, while the apples at the ends of the case will be somewhat lower than the centre, enabling the lid to be put on with the minimum amount of pressure and very little, if any, bruising.

The overlapping of varieties—especially Jonathan and Delicious—sometimes leads to trouble, the tendency being to pick the Jonathans too green and with little or no colour, in order to get rid of them before starting on the Delicious. This should be guarded against. Growers should study the regulations, paying careful attention to the colour requirements for each grade before picking.

The packing of pears for export requires every care. It is not the number of pears in the tray, but the condition on arrival, that sets the price. Consequently grade and pack carefully, using an ample supply of wood-wool, so that there will be no fear of the pears bruising in transit.

COOL STORAGE FOR LOCAL MARKET.

Growers intending to cool-store apples for the local market will be well advised to treat such fruit as carefully as that intended for export. It must be realized that only good, sound fruit can be expected to keep in cool store over a long period. Damaged fruit when put into store can never come out sound. On the other hand, the rots set up by the damaged fruit often spread throughout the case. It is a waste of money to pay storage charges on fruit that should have been sent to the jam-factories or given to the pigs. The aim should be to pack out from cool store as many cases as put in, and this can only be done where the handling and packing have been of the best. Periodical examining of fruit in cool store should be undertaken, so that each variety may be placed on the local market in the best possible condition.

ORDINARY ORCHARD STORES.

Quite a number of these home-made stores have been erected in different fruitgrowing districts, and have proved successful. Although the fruit cannot be kept in them for such a long period as in mechanical cool stores, yet a glut on the market can be often avoided by their means. Some growers are apt to place very inferior fruit in these stores. This is not advisable, conditions being more favourable for decay, and consequently rots spread faster. The question of ventilation is very important in this class of store, and ample should be provided in order to allow for the elimination of gases that accumulate. Stacking should be done so as to allow free access of air all round the cases, and humidity should be attended to.

—G Stratford, Orchard Instructor, Motueka.

Citrus-culture.

After such a prolonged dry spell, followed by late summer rains, the trees will rapidly put forth new growth. This growth will be softer than in normal seasons, and more disposed to suffer from even light frosts in winter. For this reason nitrogenous fertilizers are better withheld, as they will tend to make the growth even more succulent. Potassic or phosphatic fertilizers will be required, and if any nitrogen is used it should be slow-acting. Superphosphate, 8 cwt., plus sulphate of potash, 2 cwt., per acre, is a good dressing to meet most cases.

There are many citrus-groves which will naturally benefit by an application of lime. Where no lime has been applied for many years, 1 ton per acre, to be followed by ½ ton every third year, is correct. Where such a dressing of lime is made, applications of artificial manures should be deferred until later.

Autumn working of the land should aim at keeping the soil from consolidating on the surface, and so arranging the contour as to provide an easy get-away for the heavy rains expected later. Unless this is done prior to sowing a green crop it is rarely possible to do it later, and water stagnates in odd places, to the detriment of the trees.

After thus preparing the land it is seasonable to sow a green cover-crop. Blue lupins are ideal for the purpose, and provide the largest quantity of green material to turn under later. Oats and tares or Lotus angustissimus are also quite good. Super or lime, whichever is being used, should be used at sowing-time; but where lime is used the super should be applied later, when the crop is turned under.

There will now be a certain amount of pruning required. First, the worn-out parts of fruiting-wood should be removed, as also all dead wood. When dealt with at this season these are more readily discernible than will be the case later, when the trees are in full vegetation. All branches which sweep the ground or hang within 1 ft. of the soil should be cut away, as it is on these that spores of citrus brown-rot first find lodgment.

The loss from this brown-rot is great every year, varying in severity according to the continuity of rainfall, but even under the best conditions it causes quite sufficient loss to justify preventive measures. These are really of a threefold character: Firstly, sterilization of the soil, where the spores reside. This is usually done with sulphate of iron, 2 lb. per tree, worked into the surface soil; but White Island No. 1 Product, 3 cwt. per acre, is in many cases giving even better results, as it not only contains various forms of iron, but sulphur and other elements which correct chlorosis and give general tone to the trees. Secondly, pruning away lower branches, so that spores missed by the sterilization will not be so readily lodged on the trees by rain-splashes from the soil. A cover-crop of green growth under the trees is also beneficial, as it acts as a carpet against splash. Thirdly, an application of bordeaux, 4–4–40, to the trees in late autumn, which acts as a preventive to the establishment of such spores as may chance to alight on the covered parts. In certain localities where the disease is not troublesome, or in seasons of lesser severity, part of this threefold treatment may suffice, but it is well to be prepared in its entirety.

—W. H. Rice, Orchard Instructor, Auckland.

POULTRY-KEEPING.

THE WINTER LAYERS.

On most poultry plants the great majority of the adult hens will now be preparing for or passing through the moulting process. Consequently in most cases they will not come into profit again till the end of winter or early spring. Obviously, now is the time when the pullets must be looked upon to fill the egg-basket, and for this reason the chief concern of the poultry-keeper during the next few weeks should be to give the pullets the best possible management, in order that they may produce to their maximum capacity. In the first place, the greatest care must be taken to prevent them going into a moult. Reference is, of course, made to the pullet which has been bred to lay in winter and is now about six months old. It is realized that the great bulk of the early-hatched birds which have been producing for several weeks will now be moulting or be on the point of it, and this in spite of anything that can be done for them. In the case of pullets which have only just started to lay, or which are on the point of laying, it is entirely different. If these young birds are given proper management they should not moult until next autumn, and will continue producing till that period. On the other hand, if they are subjected to improper treatment now or in the near future it is more than likely that they will moult with their elder sisters, and at the expense of the anticipated winter egg returns.

The first thing necessary to prevent the pullets which were hatched out to lay in winter from moulting at present is to provide them with every favouring condition; above all, the management they receive must be uniform to a degree. They should be placed in their winter quarters well before the laying-period commences—this in order that they may get over the changed conditions and feel at home before commencing to lay.

A change of food will usually upset any laying flock, but this applies with double force when young pullets are concerned, having the effect of putting the birds into a premature moult. There is no doubt that sudden changing of food and quarters is more responsible for pullets going into an early moult than any other cause. Not only does the maintenance of one diet often prevent a false moult, but it also encourages a bird to maintain maximum production. That laying birds require frequent changes of diet is one of the theories which does not hold good where pullets are concerned. Laying pullets should not only be provided with a liberal and uniform class of food at regular periods, but in addition it should be of a high-grade character. Beware of poor-quality foodstuffs, especially when the feeding of the pullets is being considered.

Some of the so-called pollard and, indeed, wheatmeal which is being offered to poultry-keepers is next to useless for promoting winter egg-production. In buying food the best is always the cheapest in the long-run, even if its cost is a little greater. It should be remembered that one egg in winter is worth two in summer, and that any additional cost in securing the winter egg is more than paid back by the increased price obtained for it.

In order to obtain a heavy winter egg-yield, animal food, such as boiled meat or its substitutes—blood or meat-meal—is essential. Where milk is available this may to a great degree take the place of meat. Sharp gravel-grit, crushed oyster-shell, and clean water should be always available to the birds. The house should have ample room—not merely enough for the birds to roost in by night, but sufficiently large to accommodate and provide exercise in comfort during unfavourable weather. Exercise is a most important matter, and the best way of inducing this is to cover the floor of the house with litter, in which the grain foods should always be scattered. It is also a wise course to feed the birds in the house at all times, as waiting about in the yard for feeding-time on cold, wet days is not conducive to heavy laying. It is only the pullet provided with dry footing, both by day and night, that can possibly give her maximum egg-yield during the winter months. In short, everything should be done to provide as near as possible conditions similar to those which prevail during spring and summer—the natural laying season for bird-life.

MORE ABOUT CULLING.

On well-managed poultry plants the chief culling of undesirable stock will already have been carried out, but this is not to say that further culling is unnecessary. Indeed, if the best results are to be obtained the weeding-out of inferior birds should be done to a more or less extent throughout the whole year. It is a mistake (although a common one) to conclude that because the weak specimens have been eliminated from the flock in, say, February or March all the remaining stock on the plant will pay to keep for another year. It should be remembered that every inferior bird retained on the plant is a drain on the profits made from the heavy layers, and when the drones are in good numbers they may easily make the difference between success and failure. The keen poultry-keeper is always on the alert when working among his flock to detect birds which give evidence that they have passed their best period of usefulness. A fowl may give every indication during the autumn months that it will be profitable to keep for another year, but there is no telling when, owing perhaps to some abnormal internal condition, or through impaired vigour due to strain brought about by heavy egg-production, the same bird, in the eye of the practical man, will instantly be declared a cull.

In these days of high-priced foodstuffs the hard maxim should always be applied that when a bird is not paying its way, nor likely to in the future, it should be got rid of. Again, any bird must be regarded as useless if it does not possess the desired constitution, as it will then not be able to maintain its laying-power for any lengthened period, while, worst of all, it is always specially susceptible to disease and parasitic infection.

To the student of egg-producing form a striking illustration of the type of bird desired may be seen towards the close of a year's egg-laying competition. Having the available individual egg records to date of birds representing noted breeders from practically all parts of the Dominion, an opportunity is afforded of not only studying egg-laying performance, but also the external signs indicative of high,

medium, or low egg-laying capacity. The birds in the running towards the end practically all bear a somewhat similar general appearance, having an oblong tapering body (broad and deep behind), and a well-developed crop, running to a fine neck, carrying a clean alert head, also flat-boned legs set well to the rear and wide apart. The feathering is tight, and the birds are thickly clothed all over, or what is known as "hard" feathered. They also look full of life, and in many cases bear every indication of laying-power and the ability to maintain it to the end.

Where small nest-boxes are used the tails of these good laying birds will be more or less broken, and in some cases worn down to a stump. Obviously, the more often a bird visits its nest the more ragged or worn the tail becomes. These leading birds are constantly on the move, and although they possess their old feathers and worn-down tails they present a strong appearance.

Perhaps the strongest point to be observed about these birds that are fighting out a finish in the competition is that they are too busy to go into a deep moult. They usually moult by degrees, and continue laying at the same time. Any feathers cast are rapidly replaced by new ones, until by degrees a new and complete plumage is produced. To the unobservant eye, however, such a gradual moult would never be noticed. The weak pens, on the other hand, will have gone through their moult and be carrying their new plumage. Obviously, the latter type have been resting while the late moulters have continued producing, and doing this at a time when the market price of eggs is on the up grade. Not only this, but it will usually be found that the leading birds and late moulters will be laying again before or as soon as those which have moulted early.

It is not advisable, however, to choose breeders on late moulting and laying points alone, for the late moulter, or, indeed, the best layer, is not necessarily a desirable breeding specimen. In selecting hens for breeding purposes, points bearing on production-capacity are matters of prime importance; but in combination with these the birds should possess breed-type and conform to standard weight requirements of their breed if a heavy-producing strain is to be built up and maintained. Even at the termination of egg-laying competitions it is not uncommon to see in the front rank of performers more or less weedy specimens of the breed they represent. Some are practically broken down, owing to the year's egg-laying having impaired their constitutional vigour. On the other hand, birds are to be seen that are probably only a few eggs behind the others, but have ample "timber," with good breed-type and constitutional points stamped all over them. Obviously, specimens in the former category could not be expected to produce desirable progeny. After all, in poultry-keeping it is not the fact of having an odd phenomenal producer that spells success, but rather the possession of a good average laying flock. This can be maintained only by a sound system of breeding, feeding, and general management. Breeding from birds on egg-laying performance alone will not attain the objective.

—F. C. Brown, Chief Poultry Instructor, Wellington.

THE APIARY.

AUTUMN OPERATIONS.

By the time these notes are in print the month of March will be well advanced, and beekeepers will be fully occupied in doing the last of their honey-extracting and preparing their colonies for the winter.

Should the autumn be mild, final extracting may be later than usual on account of a prolonged flow of nectar. Thistles will probably yield more nectar at this period than other plants, and will, when mixed with clover or catsear, produce a white, clear, and delicately flavoured honey which forms a splendid exporting article.

Should late extracting be necessary, great care must be taken to check robbing; an apiary may soon become demoralized if precautionary measures are not taken. When once robbing starts it may prove a difficult matter to stop. Thousands of bees may be killed by endeavouring to enter the wrong hives, and thereby the strength of the colonies be very much weakened; or the colonies may even be rendered incapable of going through the winter. When robbing has commenced, do not open any more hives until the trouble is controlled. This may be done by syringing the entrances of the offending hives with water, and in bad cases by placing wet grass over the entrances until the disturbance has been quelled. Do not on any account leave combs of honey open to attack, or keep a hive open an instant longer than necessary. If the colony attacked should be weak, contract the entrance in addition to the above-mentioned precautions. It may be necessary to suspend work in the apiary during the day, doing as much as is thought advisable in the early morning.

FOUL-BROOD.

At all times of the year foul-brood is a menace to the beekeeping industry, and it is advisable to always keep a sharp lookout for any symptoms. This is especially the case during the spring and autumn months; and before pronouncing any colony fit for wintering the brood-nest should be carefully examined for the slightest sign of the disease. If a trace is discovered, or the disease is found in a more advanced state, judgment must be used as to the advisability of destroying the colony completely or of treating it.

WINTER STORES.

As advised last month, do not fail to determine the quantity of stores available in the hives for winter consumption. A plentiful supply is sound economy, and my advice is that not less than 30 lb. of honey be left in each hive. There are occasions when late swarms have not gathered sufficient for their own wintering purposes, and then they must be fed either with clean, healthy honey, or with sugar-syrup. Never use honey from an unknown source.

CLEANLINESS AND ORDER.

Before finally leaving the hives for winter it is a good plan to scrape the bottom-boards free of all the rubbish that has accumulated during the summer, thereby helping to keep the bees in a healthy condition. Also scrape the alighting-boards clean, and clear any

long grass surrounding the hives; this will tend to keep away dampness. The hives should be placed on blocks several inches off the ground, and in a sheltered position where they may receive a considerable portion of the day's sunshine. Any leaky covers or split supers should be removed from the hives, and sound ones put in their place. Remember bees require dryness and warmth.

—E. A. Earp, Senior Apiary Instructor, Wellington.

HORTICULTURE.

TOBACCO-LEAF.

THE operation of harvesting the tobacco crop will now be nearing completion—indeed, much of the leaf is already cured. On this point it is well to be certain, as unless the leaf-stems are well dried out there is a danger of them mildewing. After curing, the sooner the leaves are stripped from the plant-stalks the better. Commence by conditioning the leaf—that is, admit or create a damp atmosphere, the result of which will quickly be seen by the blade of the leaf becoming flaccid and soft. In this condition only may it be handled without damage. The neglect of this precaution is the cause of considerable loss by depreciation every year. The method, then, is to take the stalk in the left hand and strip the leaves carefully without damage. Meanwhile examine the leaf and place it in its special grade. A dozen or so of the leaves are then taken, and the butts of the stems are bound with a tobacco-leaf used as a tie, which is finished by the stem end being tucked through the centre of the butts. In this way all the leaves are made up into "hands." The grades adopted depend on the purpose for which the leaf is to be used and the market, but generally it is based on colour and quality. The unbroken leaves of best quality are usually found about the middle of the stalk. Keep the grades separate.

When enough grade leaf has been accumulated it should be baled, branded, and consigned. In doing this care is again necessary to see that the leaf is in right condition. Putting dry leaf into slack bales is a poor way of treating a crop that has cost so much labour. To prevent breaking the leaves they should be just sufficiently damp to be pliable. Build the bales in a press and make them sufficiently firm to avoid movement within the bale when it is handled.

Where the grower decides to hold the leaf it is important to avoid holding it in a shed subject to extreme changes in weather conditions. Tobacco is a product that requires good storage. In most cases it would probably be best to bulk the leaf on a platform and cover it securely with a canvas cover. In doing this there should be no attempt to carry out a fermentation of the bulk, and, in any case, the tobacco should be examined frequently at first, in order to see that a high temperature does not develop.

TREATMENT OF TOMATO AREAS.

The outdoor tomato crop will soon be finished, and where it is desired to replant the land with this crop next season it is specially desirable to promptly and carefully clean up and burn the remains of the old crop—roots and tops. The practice of some growers to sow

down the area between the rows with a cover-crop in the autumn is much to be recommended. The old tomato-plants can then be lifted, and the cover-crop remains to mature. In these motor-car days, when strawy manure is not available, the green cover-crop is the only alternative method for conveniently supplying humus—that is, carbon, fibre, nitrogen, &c. — to the soil, raising the temperature, improving its mechanical condition, and supplying an ingredient that is otherwise very expensive.

SMALL-FRUITS AND NUTS.

Plantings of strawberries in their second or third year should now be making a good recovery after the cropping season. Take the opportunity every fine spell offers of putting the hoe through this crop and keeping the weeds down.

Cape and Chinese gooseberries, tree-tomatoes, passion-fruit, walnuts, hazelnuts, chestnuts, and almonds will now be ripening. Do not let the nuts lie on the ground long enough to discolour. A good method often is to lay a cloth round a tree and shake the branches with a pole, when all nuts near maturity will fall and are easily gathered. If this is done at short intervals the harvesting is greatly simplified. Spread the nuts in trays in a dry airy position and dry them up well, going through them occasionally and stirring them over. In this way rancid and mildewed nuts will be avoided. Riddles will afterwards take out small nuts and waste, and a little hand-picking should then produce samples that are satisfactory. Some of these crops can be grown in odd corners and waste spaces ; they are worth more consideration than is commonly given in this country.

VEGETABLE CROPS.

The dry summer experienced will be responsible for rather a lean time so far as winter vegetables are concerned. The quantity will be short and the quality not quite up to the usual standard. Savoy cabbages planted shortly before Christmas are among the best in that line. They had the benefit of some rain and got established before the dry weather. Moulding of the celery crop should now be finished. Spring cabbage can be planted out

Sow cabbage, cauliflower, and lettuce for planting out in early spring. The lettuce seedlings often suffer from " rust " if the winter season is severe. The best preventive is to give them the shelter of a cold frame ; but here again is a danger of " damping off "—a trouble that is sometimes severe and often not perceived until the plants are put out. In the winter keep the foliage of these plants dry, but give them plenty of air. Sow rather thinly.

Harvesting marrows, pumpkins, onions, and potatoes will make the coming month a busy one for many. Consider each crop carefully, and decide if it is suitable for long storage ; grade it well and give it good accommodation.

SOIL COMPOSTS AND LIME.

The question of the use of quicklime as an ingredient in the compost-heap has been raised recently. Quicklime, like everything else, is under certain circumstances of very great value, and under others it is the cause of injury and loss. It is of value as an addition to a drained swamp soil that is heavily charged with humus. Its effect there will

be to further decompose the humus and liberate the nitrogen, correct acidity, and so permit the operation of the bacteria of fermentation which transform the nitrogen into nitrates, a soluble form in which it is immediately available to the plant. It must also be realized that lime is readily washed from the soil. Its mechanical effect on a stiff, heavy soil inclined to clod is well known. Again, some plants have a strong partiality for lime—the legumes, for instance. But where quicklime forms an ingredient with animal manures or sulphate of ammonia in composts its effect causes great loss owing to its rapid action in liberating the nitrogen as ammonia-gas. Also, it is to be remembered that an alkaline soil is unsuitable for some plants, and, as it appears from recent experiments, striking cuttings.

For agricultural purposes quicklime is rarely used as it comes from the limekilns. It is then a lime oxide, and is usually exposed to the atmosphere, from which it slowly draws moisture, which causes the burnt rock to crumble. It is then lime hydrate and in a suitable state for adding to the soil. For light soils lime carbonate ground fine—that is, lime in its natural state—is often preferred. The outstanding effect in the use of quicklime is its rapid action in decomposing organic material, an effect that is useful in horticulture when operated in moderation. Excessive use just means burning up important plant-foods to waste.

—*W. C. Hyde, Horticulturist, Wellington.*

INVENTIONS OF AGRICULTURAL INTEREST.

APPLICATIONS for patents, published with abridged specifications in the *New Zealand Patent Office Journal* from 31st December, 1927, to 8th March, 1928, include the following of agricultural interest:—

No. 57002: Treatment of natural phosphates; F. G. Shepheard, Penrose. No. 57592: Leg-rope support; G. T. Arcus, Levin. No. 58001: Separator-driving device; Aktiebolagat Separator, Stockholm. No. 58806: Fence-dropper; A. Arthur, Sydney, N.S.W. No. 58845: Packing-case for eggs; R. Hall, Hobart, Tasmania. No. 59282: Cool-chamber louvers; J. M. Maxwell, Dunedin. No. 59311: Milking-cup; O. A. Bruun, Copenhagen, Denmark. No. 59428: Shaping butter by extrusion; Toledo-Berkel Proprietary, Melbourne, Vic. No. 59573: Butter-churn conveying element; J. O. Connell and H. H. Kerr, Kensington, Vic. No. 59586: Ploughshare; J. R. Taylor, Duntroon. No. 56587: Wire-strainer; E. Cairn and J. B. Dunning, Pembroke. No. 57345: Poultry-food preparation; E. G. Schmoll, Hastings, and C. L. Schmoll, Napier. No. 58024: Scutching-machine; M. H. Wynyard, Auckland. No. 56822: Scarifier; N. McEwan, Wyndham. No. 57387: Sterilizing cow-udders; S. Finch, Ohingaiti. No. 57921: Cream-cooler; S. Armstrong, Tuhikaramea. No. 58291: Washing fibre; J. R. Hynes, Foxton. No. 58294: Electrification of seeds; J. Christofleau, La Queue-les-Yvelines, France. No. 58900: Milk-cooler; C. Cooper, Eltham. No. 59236: Manure-drill; C. Topham, Kaikohe. No. 59309: Sheep-shear tension-nut; R. A. Lister and Co., Ltd., Dursley, England. No. 59404: Pasteurizing-apparatus; Creamery Package Manufacturing Co., Chicago, U.S.A.

Copy of full specifications and drawings in respect of any of the above may be obtained from the Registrar of Patents, Wellington, price 1s. All fees must be paid in advance in cash, or paid to the Public Account at a branch of the Bank of New Zealand and the bank receipt sent to the Patent Office; or fees may be remitted by Post Office order or postal note.

Fruit-export Control Board.—Mr. J. L. Brown, of Redwood's Valley, Nelson, has been appointed a deputy member of the Board to act for Mr. H. E. Stephens while the latter is absent in Britain as marketing representative.

TESTING OF PUREBRED DAIRY COWS.

FEBRUARY CERTIFICATE-OF-RECORD LIST.

Dairy Division.

THE appended list gives particulars of cows which received certificates during the month of February.

Interested readers will be aware that the annual review of the C.O.R. system is usually published in the March issue of the *Journal*. Each year, however, there is difficulty in getting a certain number of owners to advise dates of calving subsequent to test, and also to return necessary declarations for cows already qualified. This year the difficulty has become accentuated, and it has therefore not been possible to compile the review for the year 1927 in time for the present issue. It is hoped, however, that all outstanding particulars will be to hand in sufficient time for the review to appear in the April *Journal*.

LIST OF CERTIFICATES ISSUED, FEBRUARY, 1928.

* Cow milked three times daily during whole lactation period. † Milked three times daily during part of period.

Name of Cow and Class.	Tested by	Age at Start of Test.	Fat req'd for Cert.	Yield for Season.		
				Days.	Milk.	Fat.
JERSEYS.						
Junior Two-year-old.		Yrs. dys.	lb.		lb.	lb.
Ngahiwi Miss Romance	W. J. Freeth, Waitara ..	1 348	240·5	348	8,935·0	545·56
Orange Dale Rower's Fancy	W. J. Hall and Son, Matatoki	1 348	240·5	365	8,213·5	460·03
Briar's Ladylove ..	J. K. Watson, Tatuanui ..	1 247	240·5	365	7,720·6	450·55
Ngahiwi Prude ..	W. J. Freeth, Waitara ..	2 13	241·8	365	8,515·3	444·81
Springhill Juno ..	A. J. Harris, Bombay ..	2 32	243·7	365	6,595·8	433·24
Uruti Olga ..	W. Oxenham, Uruti ..	1 344	240·5	350	6,705·6	425·27
Fern's Heroine ..	C. Parker, Hairini ..	1 287	240·5	365	7,298·3	423·98
Twylish Rose ..	G. S. Clarke, Te Awamutu ..	2 16	242·1	365	7,722·9	419·66
Junette	E. O. Jepson, Te Awamutu ..	2 42	244·7	340	6,971·1	413·60
Neat Bellbird ..	J. C. Hodgson, Whakapara	1 348	240·5	365	7,315·6	406·21
Holly Oak Fantasia ..	T. A. Jennings, Mauriceville	1 263	240·5	365	5,939·4	388·50
Kitty of Rosy Creek ..	Jas. Nicolson, Kaupokonui	2 2	240·7	365	7,721·6	384·44
Roslyn Sweet Faith ..	A. J. Harris, Bombay ..	1 360	240·5	365	6,424·0	371·94
Bilberry's Flowerette	H. Naylor, Te Rapa ..	1 327	240·5	356	7,591·7	345·86
Noble Veronica ..	C. Parker, Hairini ..	2 52	245·7	294	6,466·4	342·22
Meadowvale Keepsake	W. Oxenham, Uruti ..	2 12	341·7	253	5,334·5	304·73
Spick of Dilkusha ..	H. Naylor, Te Rapa ..	1 286	240·5	311	5,200·9	299·16
Bilberry's Nellie ..	H. Naylor, Te Rapa ..	1 356	240·5	293	6,244·1	291·23
Bilberry's Doreen ..	H. Naylor, Te Rapa ..	1 342	240·5	344	5,168·6	284·23
Te Matai Win ..	H. Naylor, Te Rapa ..	1 284	240·5	248	5,022·3	263·58
Manor Farm Topsy ..	E. Harding, Woodville ..	2 29	243·4	357	4,562·2	259·33
Manor Farm Betsy ..	E. Harding, Woodville ..	2 50	245·5	311	5,029·5	253·07
Senior Two-year-old.						
Rewa Frieze ..	G. B. Hull, Wellington ..	2 301	270·6	365	9,753·9	518·51
Four-year-old.						
Woodstock Feerie ..	A. E. Watkin, Takanini ..	4 364	349·9	365	14,051·2	729·05
Silverdale Jenny ..	G. Hodgson, Whakapara ..	4 245	338·0	322	9,318·8	515·20
Silverstream Genoese	G. B. Hull, Wellington ..	4 3	313·8	365	8,057·0	493·71
Ohio Bilberry's Eminence	H. Naylor, Te Rapa ..	4 342	347·9	326	9,397·0	428·65
Raleigh's Success ..	A. E. Peppercorn, Cambridge	4 27	316·2	315	7,023·3	393·79

LIST OF CERTIFICATES—*continued.*

Name of Cow and Class.	Tested by	Age at Start of Test.	Fat req'd for Cert.	Yield for Season.		
				Days.	Milk.	Fat.
	JERSEYS—*continued.*					
Mature.		Yrs. dys.	lb.		lb.	lb.
Parakau Flower ..	W. T. Dazeley, Pukekohe ..	5 31	350·0	365	12,672·8	672·29
Orange Dale's Concord	W. J. Hall and Son, Matatoki	7 8	350·0	365	10,106·2	596·20
Richwood Molly ..	C. Parker, Hairini ..	8 24	350·0	364	10,228·6	587·54
Alfalfa Lassie ..	A. E. Watkin, Takanini ..	5 8	350·0	359	9,042·7	531·33
Sylvian Dale ..	J. K. Watson, Tatuanui ..	9 257	350·0	365	7,872·8	515·04
Silverdale Alma ..	G. Hodgson, Whakapara ..	5 361	350·0	365	9,404·9	503·70
Silver Dollar ..	G. S. Clarke, Te Awamutu..	5 307	350·0	325	8,649·3	473·01
Canadian Zealandia ..	R. K. Garland, Matamata	5 118	350·0	365	7,230·8	424·29
	FRIESIANS.					
Junior Two-year-old.						
Brundee Maid† ..	W. S. Gallon, Dalefield ..	1 343	240·5	327	14,552·0	501·97
Ryvington Pontiac Segis Maid†	T. O. Hodgson, Tamahere (Estate)	1 219	240·5	353	9,363·1	347·65
Senior Three-year-old.						
Lebrina Clothilde Alcartra	Piri Land Co., Auckland ..	3 214	308·4	120	8,284·3	316·43
Mature.						
Milkmaid Korndyke†	Cameron Bros., Stratford ..	6 121	350·0	365	22,525·9	826·13
Cluny Pietje Transvaal†	W. S. Gallon, Dalefield ..	6 5	350·0	365	20,924·4	722·99
Coldstream Pontiac Wayne	O. A. Cadwallader, Greytown	7 53	350·0	182	14,044·1	504·94
Anawhata Colantha Johanna	P. F. Boucher, Kumeu ..	5 27	350·0	294	12,064·2	461·03
	MILKING SHORTHORNS.					
Junior Two-year-old.						
Riverdale Grace 7th†	T. W. Wardlaw, Waimana	1 327	240·5	365	10,491·2	424·92
Senior Four-year-old.						
Allandale Garnet† ..	R. S. Allan, Hatuma ..	4 318	345·3	365	15,891·1	550·80
Riverdale Grace 4th†	T. W. Wardlaw, Waimana..	4 347	348·2	305	12,653·3	440·24
	RED POLLS.					
Two-year-old.						
Glen Eden Tablemaid	J. G. Donaldson, Stirling ..	2 62	246·7	310	6,416·4	264·47
Three-year-old.						
Waihou Pip ..	Wm. Jackson, Waihou ..	3 28	279·8	365	6,441·8	282·57
Mature.						
Glen Eden Annie ..	J. G. Donaldson, Stirling ..	6 37	350·0	365	11,480·9	437·90
Waikato Alpha ..	Wm. Jackson, Waihou ..	..	350·0	365	12,099·9	430·87
	Second-class Certificates.					
	Jerseys.					
Mature.						
Perfect Life ..	G. S. Clarke, Te Awamutu..	5 355	350·0	357	9,274·7	553·48
	Red Polls.					
Four-year-old.						
Otahuna Red Rose ..	J. G. Donaldson, Stirling ..	4 89	322·4	365	8,833·7	347·07

ANSWERS TO INQUIRIES.

IN order to ensure reply to questions, correspondents must give their name and address, not necessarily for publication, but as a guarantee of good faith. Letters should be addressed to the Editor.

HORSE WITH STRINGHALT

K. T. M., Te Poi :—

I have a three-year-old unbroken gelding that has stringhalt. It was noticed after he had been driven over a dozen miles on a hot day. He did a good bit of galloping around, and became very hot. Do you think this was the cause of the stringhalt, or, as was suggested to me, could it have been caused by castration (performed over a year ago) ? Can anything be done for stringhalt ?

The Live-stock Division :—

The cause of stringhalt is obscure ; therefore it is impossible to say whether or not the galloping mentioned brought on the trouble, although it is quite likely that the excessive exertion hastened the symptoms, the actual cause of the disease being latent in the horse previous to the incident related. Castration is not considered to be a cause of stringhalt, as this ailment affects old horses more frequently than it does young animals. Regarding the treatment of stringhalt, operations of almost every conceivable nature have been tried on the leg in the hope of securing recovery, but the veterinary surgeon cannot be reasonably certain of effecting a cure in any case. In these circumstances we would advise you to turn your horse out for a spell of, say, three months, the animal having youth in his favour.

"FAIRY RINGS" IN LAWNS.

J. W. N., Gisborne :—

Can you advise me what treatment should be applied to "fairy rings" appearing in a tennis-lawn ? The number of rings has increased since last year, when only one or two were noticed.

The Horticulture Division :—

To destroy "fairy rings" the ground should be thoroughly soaked with sulphate of iron in the proportion of 1 lb. to 1½ gallons of water. This treatment should be repeated twice at intervals of a fortnight, with the solution at half the previous strength. The fungus never grows twice in the same place ; it spreads outward all the time. Therefore the soil chiefly to be treated is a ring beyond where the fungus is now growing, and where so far no fungus has been seen. Where the fungus has previously grown it leaves a mat of mycelium in the soil. This for a time renders the soil almost impervious to water, and the grass is starved and dies out. After a time the mycelium dies, the soil is left enriched with nitrogen, and, permeability being again restored, the grass grows stronger than before infection. The sulphate-of-iron treatment will disfigure the grass, but it soon recovers.

FOOT TROUBLE IN DAIRY COWS.

F. W. G., Kihikihi :—

Will you please advise me on the following matter : Several of my dairy cows, notably those which milk fairly heavily and are of mature age, have developed a tenderness in their feet, more especially the hind feet. The hoof in each case is cracked and ragged-looking, too long in the toe, and inclined to flatness instead of the usual slope from the coronet. The farm is mainly high land, in no way waterlogged in winter, and the ground not hard or baked even in dry weather. The pasture is well top-dressed, mainly with superphosphate, and the stock have the usual rock-salt lick. Lately I have given the dairy cows access to boxes containing bonemeal and coarse salt.

The Live-stock Division :—

In many instances, unless the feet of dairy cows are kept regularly dressed and trimmed, especially the hind feet, they will grow long at the toe and begin

to crack. The weight of the animal with long feet is thrown back on the heels; therefore tenderness and lameness will result. A good instrument to use for cutting the feet is a blacksmith's hoof-cutters. The instrument resembles the pincers used by blacksmiths, but has one edge thick and blunt. After using this the hoof rasp may be used to trim and round off the horn. A tenon saw may also be used, but this is awkward to handle and not so satisfactory. The growth and quality of the horn are also influenced by the general health of the animal. Whether this is caused by a deficiency, malnutrition, or any other disease (for instance, digestive disorders), steps to rectify should be taken, and the regular trimming of the feet is of great importance. The nature of the ground the animals have to walk on is also a fruitful source of trouble.

DETAILS OF WALK-THROUGH MILKING-SHED.

"AUSSIE," Hastings:—

I intend to build new cow-bails on the walk-through plan. In the Department's Bulletin No. 87 the width of bail is given at 2 ft. 3 in. As I cover my cows in the winter (I milk all the year around) the width mentioned seems too fine for removing and replacing the covers, and I should like an opinion whether 3 ft. would be too wide and allow the cows too much room.

The Dairy Division:—

We may say that 2 ft. 3 in. is the usual width allowed for cow-bails in walk-through sheds. The bulge of the cow is beyond the end of the dummy barrier, and the space available should be ample for rugging. If your cows are exceptionally large a width of 2 ft. 6 in. would probably be enough. In connection with the general plan given in the bulletin we may add that some prefer the width of the slab of concrete outside the end of the shed to be 2 ft. 6 in. instead of 5 ft., as cows are less likely to turn round on the narrower space; also that the doors open all one way. The posts of the fence round the yard are best placed on the outside.

INCIDENCE OF TWIN LAMBS.

"SUBSCRIBER," Pleasant Point:—

Would you please tell me the reason why so many more twin lambs arrive at the beginning of the lambing season than later on? If one kept more rams, and changed them at intervals, would the ewes be likely to have more twin lambs?

The Live-stock Division:—

The greatest factor which influences the incidence of twin lambs is the condition of the breeding-stock at the time of mating. Ewes which have been "flushed" before mating always give a greater percentage of lambs (provided the rams are in breeding-condition) than ewes unflushed. The fact that a greater percentage of twins are born at the commencement of the season points to this as being the reason. Some of the single-lamb ewes may even be fortunate in having a lamb at all, owing to having been in an unflushed condition. You may be confident that twinning is not due to the ram, for if he is capable of impregnating the ewe that is all that is required; the rest depends on the ewe.

ANT-NESTS ON BOWLING-GREEN.

W. NYE, Foxton:—

Could you inform me the best way to eradicate ants on a bowling-green? Here the ants are simply spoiling the green, leaving holes where they have their nests. Any information in regard to checking the pest will be appreciated.

The Horticulture Division:—

The simplest way of destroying the ant-nests in your bowling-green would be to pour a small quantity of carbon bisulphide into the holes and cover them with a little soil to retain the gas evolved. The material is very volatile and inflammable, so that suitable precautions should be taken.

WINTER LICK FOR LAMBS.

J. D., Okoia :—

I should be glad of a recipe for making a lick for lambs. We have some difficulty in carrying a big mob through the winter, and it appears to me that there is something lacking in the soil which the lambs require. I have plenty of rock salt at their disposal.

The Live-stock Division :—

We take it that you exclude the possibility of internal parasitic infestation when you refer to difficulty in carrying the lambs through the winter. Overstocking and badly drained pastures are two of the main factors in the spread of parasitic trouble. A lick containing the following ingredients is recommended: Common salt, 40 parts; phosphate of calcium, 20 parts; bicarbonate of potash, 10 parts; sulphate of iron, 3 parts. This will supply any deficiency of salts in the pasture, but by itself is not sufficient if parasites are at the bottom of the trouble.

WEATHER RECORDS: FEBRUARY, 1928.

THE Director of the Dominion Meteorological Office (Dr. E. Kidson) reports as follows :—

GENERAL NOTES.

THE month began with the Dominion in the throes of one of the driest spells experienced for many years, but after the first week the prospects of rain began to improve gradually, each successive pressure disturbance causing more widespread rain than its predecessors. On the 21st conditions became definitely favourable, and rains, though still far from general and in most cases only light, fell over large parts of both Islands. The type of weather changed completely thenceforward. General rains fell on the 23rd–24th and the 26th–27th. From the 24th there was a considerable drop in temperature. Snow fell on many of the mountain areas, especially in the South Island, during the 26th–27th. As far as monthly totals are concerned, the rain of the latter end caused February to lose much of its droughty character. Though the first three weeks were almost everywhere very dry, moderate to heavy falls were experienced generally during the last week, and scattered places, especially in the North Island, received more than the average. The deficiencies were most serious in the Taranaki and Nelson Provinces and in parts of Manawatu. On the west coast of the South Island from Greymouth southwards most places appear to have had more than the normal February fall.

As regards pressure, the most prominent feature of the first ten days was one which the month had inherited from January—namely, the persistence of high pressure over the northern portions of the North Island. Two tropical cyclones were experienced in the Pacific islands to the north-east towards the end of January. Subsequent to their passage the pressure rose in that region, and one of the conditions adverse to rain in New Zealand appeared to have been removed. Low barometers were, however, still the rule over Australia, where very heavy rains occurred. It was not until after anticyclonic conditions had been fully established, on the 23rd, in Australia that the wet period commenced in New Zealand, the low pressure area now shifting to the Dominion.

The rapid movement of pressure systems which has been commented on in these notes for months past was no less pronounced during February. A depression would cross the South Island within about thirty-six hours of passing Hobart. Such depressions as affected the Dominion were mainly shallow waves. Those recorded reached us on the 2nd, 5th, 9th, 10th, 13th, 17th, 18th, 21st, 23rd, 25th, and 28th, the number being unusually large for a single month. That of the 21st was the only one which was deep on its arrival over New Zealand, but pressure was low over and to the east of the North Island from the 25th to the 28th.

Anticyclones were, as a rule, rather poorly developed during the month. Centres passed on the 4th, 8th, 12th, 15th, 22nd, and 24th. Of these, that of the 15th was the most intense, the pressure reaching 30·5 in. in some places. It has been noticed that the break of a drought, as happened on this occasion, is frequently preceded by the development of an intense anticyclone.

Winds were light on the whole, but strong southerlies prevailed, more especially from Cook Strait northwards, on the 27th and 28th. Gales were reported from many parts of the North Island.

Temperatures were generally above normal. In parts of the North Island a frost occurred on the morning of the 29th in the clear weather following the cold southerly winds.

RAINFALL FOR FEBRUARY, 1928, AT REPRESENTATIVE STATIONS.

No.	Station.	Total Fall.	Number of Wet Days.	Maximum Fall.	Average February Rainfall.
	North Island.	Inches.		Inches.	Inches.
1	Kaitaia	2·28	5	1·52	2·95
2	Russell	1·52	6	0·96	3·20
3	Whangarei	3·18	6	2·90	4·46
4	Auckland	1·61	5	0·79	3·06
5	Hamilton	4·30	7	2·12	2·96
6	Kawhia	3·74	7	1·62	2·66
7	New Plymouth	1·42	6	0·63	4·00
8	Riversdale, Inglewood ..	3·37	6	1·52	6·30
9	Whangamomona	2·05	5	1·07	4·23
10	Eltham	2·23	6	0·86	3·37
11	Tairua	7·36	4	4·16	4·10
12	Tauranga	3·21	18	1·97	3·58
13	Maraehako Station, Opotiki	2·64	6	1·44	3·48
14	Gisborne	2·38	11	1·40	3·63
15	Taupo	1·98	5	0·70	2·82
16	Napier	3·10	9	1·31	2·92
17	Maraekakaho Stn., Hastings	1·89	9	0·64	2·52
18	Taihape	2·54	7	1·03	2·52
19	Masterton	2·05	8	0·84	2·70
20	Patea	3·86	7	1·31	2·51
21	Wanganui	2·93	6	0·95	2·52
22	Foxton	1·02	4	0·44	2·06
23	Wellington	3·58	7	1·58	3·07
	South Island.				
24	Westport	1·95	11	0·40	4·37
25	Greymouth	5·99	13	1·34	5·99
26	Hokitika	7·18	11	3·09	7·31
27	Ross	11·06	9	5·73	8·45
28	Arthur's Pass	6·64	10	1·25	10·17
29	Okuru, Westland	6·82	7	1·32	7·92
30	Collingwood	1·37	6	0·58	5·63
31	Nelson	1·56	5	0·92	2·77
32	Spring Creek, Blenheim ..	1·73	4	1·20	2·25
33	Tophouse	2·72	9	0·45	4·39
34	Hanmer Springs	3·61	12	0·94	3·04
35	Highfield, Waiau	2·96	9	1·00	2·54
36	Gore Bay	4·19	11	1·52	2·93
37	Christchurch	0·94	7	0·37	1·77
38	Timaru	1·06	11	0·30	1·82
39	Lambrook Station, Fairlie ..	1·52	7	0·44	1·89
40	Benmore Station, Clearburn	1·05	5	0·51	1·36
41	Oamaru	1·35	5	0·52	1·68
42	Queenstown	1·87	8	1·11	1·98
43	Clyde	1·48	6	0·74	0·99
44	Dunedin	2·59	9	1·31	2·69
45	Wendon	2·58	7	1·00	2·03
46	Gore	2·08	11	0·78	2·65
47	Invercargill	1·85	16	0·47	2·85
48	Puysegur Point	7·54	16	1·31	4·96
49	Half-moon Bay, Stewart Is.	1·79	10	0·63	4·13

EXPORT OF PUREBRED DAIRY CATTLE IN 1927.

DURING the calendar year 1927 New Zealand exported forty-three head of purebred dairy cattle. The majority of these went to Australia and Tasmania, while a small consignment was shipped to South Africa, and one Jersey bull to Noumea. Only two breeds—Jersey and Friesian—were represented in the year's exports. The total declared value of the forty-three head was £2,232 15s., or an average value per head of £51 18s. 6d. For purposes of comparison it may be stated that the 1926 figures were forty-one head, with a total declared value of £3,521, or about £86 per head. The exports for 1927 thus show a considerable decrease in average value. The decrease is largely accounted for by the fact that in 1926 many specially selected and outstanding individuals were included in the exportations, whereas last year's shipments were comprised mainly of animals of more average quality.—*Dairy Division.*

IMPORTATION OF CATTLE FROM UNITED STATES OF AMERICA.

The following regulations under the Stock Act were gazetted on 16th February, 1928, and came into force on that date:—

1. Subject to the provisions of the principal regulations (gazetted 4th October, 1915), and to the following conditions, cattle may be introduced into New Zealand from the United States of America.

2. Every person desiring to introduce cattle as aforesaid must first obtain a permit to do so from the Minister of Agriculture.

3. Such cattle on arrival in New Zealand shall undergo quarantine at a quarantine ground for sixty days, and after liberation from the quarantine ground shall be subject to quarantine surveillance for such time as the Director may direct.

4. Every shipment of cattle must be accompanied by a statutory declaration, in the form No. 1 of the Schedule, made by the shipper of such cattle, setting forth the kind, number, sex, and brands or marks of such cattle, and declaring that all such cattle have been bred or domiciled throughout in a State where Texas fever does not exist, and never has existed; that they are at the time of shipment, and have been during the preceding six months, free from all infectious and contagious diseases; that they have not during the six months immediately preceding shipment been in direct or indirect contact with any stock infected with any such disease, and that the regulations of the United States Department of Agriculture (Bureau of Animal Industry) governing the inter-State movement of animals have been duly complied with.

5. On every such declaration there shall be inscribed a certificate, in the form No. 2 of the Schedule, signed by a Veterinary Officer of the Bureau of Animal Industry, certifying that he has, within the fourteen days immediately preceding the date of shipment to New Zealand, examined and tested with the tuberculin test such cattle and has found them free from infectious and contagious diseases. Particulars with respect to such test, showing dosages and temperature records shall be supplied with such certificate.

The schedules may be seen in the *Gazette.*

Improvement in Meat-product Processes.—Recent local work in this field was referred to by the Acting-Chairman of the Council of Scientific and Industrial Research, at its February meeting, as follows: "As the result of investigations, new processes have been elaborated whereby certain products of meat-works which, on account of excessive salinity, were useless can now be saved and utilized for the manufacture of pig and poultry feeds. The new process, which involves the use of sodium nitrate, makes possible very considerable saving in time, the preparation of a standardized product, and eliminates the waste which hitherto prevailed. Details of the dry-rendering-of-meat process have also been elaborated, and this may make a considerable advance in the meat industry. At present the question of an alternative preservative process to replace the boric preservative hitherto used in bacon-curing is receiving attention."